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HISTORICAL FINANCIAL DATA - - - DOMESTIC AUTOMOBILE MANUFACTURERS

John M. Carroll
Richard P. Schneider

Arthur D. Little, Inc.
Cambridge MA 02142



JANUARY 1979

FINAL REPORT

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16. Abstract <p>A historical financial data base was developed for the four major U.S. automobile manufacturers, focusing on the specific operations associated with production and marketing of automobiles and light trucks. The years subject to analysis were 1967-1976. The principal accounting and reporting policies of each manufacturer were examined. The accounts selected for analysis were 1) property, plant and equipment--annual capital investment; 2) special tools--annual capital investment; 3) maintenance, repairs and rearrangements--annual operating cost; 4) research and development--annual operating expense; 5) depreciation and amortization of assets--annual operating cost.</p> <p>Using a process of successive disaggregation, the consolidated corporate financial statements for each manufacturer were analyzed to develop estimates of the specific automobile - and light truck-related amounts. Data and information to assist in the disaggregation process were collected by means of a literature search and discussions with industry analysts.</p> <p>An examination of the sensitivity of each of the accounts to future changes was also performed.</p>			
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PREFACE

This report, prepared by Arthur D. Little, Inc., for the U.S. Department of Transportation, Transportation Systems Center (DOT-TSC), presents an analysis of historical financial data of the U.S. automobile manufacturers, focusing on the microeconomics of automobile production. Specifically, the microeconomic examination was concerned with developing historical information on the several critical investment and expense items which might face an altered risk environment as a result of regulated or legislated product design modifications.

Part I of this report presents the results of an analysis of current generic problems and controversies in financial reporting, leading through a progressively more specific analysis to an evaluation of the published financial statements of the automobile manufacturers as to their utility in gaining further insight on this problem. Part II presents the results of financial analysis of the specific accounts deemed appropriate for examination. The analysis was performed for each of the four domestic automobile manufacturers, focusing on the years 1972-1976 but with background information developed and analyzed for the period 1967-1976. The Appendix presents a bibliography of information sources and a discussion of the utility of various sources for the problem at hand.

The most current financial report available for this study were those of fiscal year 1976.

METRIC CONVERSION FACTORS

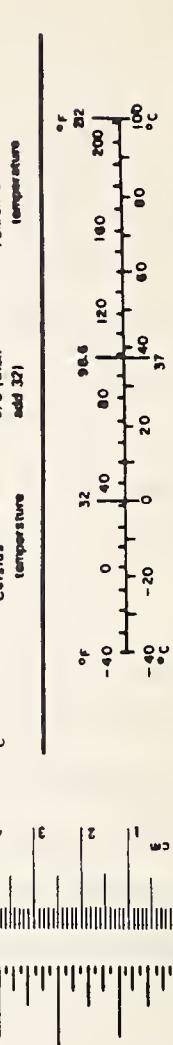
Approximate Conversions to Metric Measures

Symbol	What You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	2.5	centimeters	cm
ft	feet	.30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	.08	square kilometers	km ²
mi ²	square miles	2.6	hectares (10,000 m ²)	ha
MASS (weight)				
oz	ounces	.28	grams	g
lb	pounds	0.45	kilograms	kg
(2000 lb)				
	short tons	0.9	tonnes	t
VOLUME				
teaspoons	5	milliliters	ml	
tablespoons	15	milliliters	ml	
fluid ounces	30	milliliters	ml	
cup	0.24	liters	l	
pints	0.47	liters	l	
quarts	0.95	liters	l	
gallons	3.8	cubic meters	m ³	
cubic feet	0.03	cubic meters	m ³	
cubic yards	0.76	cubic meters	m ³	
TEMPERATURE (exact)				
Fahrenheit	$\frac{5}{9}(\text{f} - 32)$	Celsius temperature	°C	
temperature	temperature	temperature	°C	

Approximate Conversions from Metric Measures

Symbol	What You Know	Multiply by	To Find	Symbol
LENGTH				
in	millimeters	0.04	inches	in
ft	centimeters	0.4	inches	in
yd	meters	3.3	feet	ft
mi	meters	1.1	yards	yd
	kilometers	0.6	miles	mi
AREA				
in ²	square centimeters	0.16	square inches	in ²
ft ²	square meters	1.2	square yards	yd ²
yd ²	square kilometers	0.4	square miles	mi ²
mi ²	hectares (10,000 m ²)	2.5	acres	acres
MASS (weight)				
oz	grams	0.035	ounces	oz
lb	kilograms	2.2	pounds	lb
	tonnes (1000 kg)	1.1	short tons	lb
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
l	cubic meters	36	cubic feet	ft ³
l	cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (exact)				
°C	Celsius temperature	$\frac{9}{5}(\text{C} + 32)$	Fahrenheit temperature	°F
	temperature	temperature	°C	°F

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EXECUTIVE SUMMARY

The objective of this project was to develop a data base of selected financial accounts of the four major domestic automobile manufacturers, specifically as they relate to the production and marketing of automobiles and light trucks.

In order to develop a more complete understanding of the microeconomics of automobile production and marketing, one must begin by developing a historical financial data base. The primary external sources of this information are the published financial reports of the companies involved. However, the information of interest for microeconomic analysis is obscured by the conventions of financial reporting and by the consolidation of automotive with nonautomotive accounts.

The approach taken in this effort was to analyze the financial accounting basis on which the manufacturers' financial statements are prepared and then to develop historical financial data by selective disaggregation of specific consolidated accounts.

To analyze the financial accounting and reporting procedures of the manufacturers, their individual reports were examined and reviewed and a literature review was performed to develop an understanding of recent critical financial reporting issues and problems. A significant area of analysis was the difference between internal reporting and external reporting. It is the internal financial realities which shape most directly the microeconomic decision-making of the auto manufacturers.

In the context of fuel economy research and analysis, there are a selected number of financial accounts which would be most directly affected by regulated, legislated or market-induced changes in the products made, the production process, and the marketing practices of the manufacturers. All of the corporate accounts of the manufacturers were screened to determine those which would be most relevant as well as for which confident estimation could be undertaken.

The accounting policy review disclosed no overwhelming differences in accounting practices at the corporate reporting level, but did develop some revealing differences as to detail and emphasis among the manufacturers. The review of accounts developed six primary areas of focus: 1) capital expenditures for property, plant and equipment, 2) expenditures for special tools, 3) R&D expenses, 4) maintenance, repair and rearrangement expenses, 5) depreciation, and 6) amortization of special tools.

Each of these accounts can be expected to be affected by the type of changes referred to above. For each of these accounts a historical data base was developed.

The process of sequential disaggregation which was employed in the analysis was essentially a process of successive estimation, based on the relationship between key accounts and (where available) the application of external, nonfinancial evidence. The separation by geography of these accounts was typically the first step undertaken and was relatively straightforward. The next step, separation of non-automotive operations, was more difficult, but with sales and production data the estimates could be made. The subsequent separation of automotive and light truck from other automotive was somewhat more judgmental, but in all cases was accomplished with the aid of supporting evidence.

The analysts found that external (nonfinancial) data concerning these accounts was less useful in making the estimates than one might expect. (The utility of the various data sources is discussed at some length in an appendix to the study report.) Owing to the competitive environment which has obtained in the industry, the manufacturers are particularly conscious of the sensitivity of the microeconomic data of interest. Thus, the generally available published information about spending and costs, while helpful in enhancing understanding, does not typically provide the means to answer all of the questions.

The disaggregation process resulted in a complete data base for the six accounts for each of the manufacturers for each of the ten years 1967-1976. The results are reported vertically, describing the process by which disaggregation proceeded, starting at the level of published consolidated account balances from the financial statements of the manufacturers.

The data base, when combined with similarly disaggregated production, revenue, and cost time series, will lead to a better understanding of the microeconomics of the production and marketing of those vehicles most likely to be affected by fuel economy regulation.

PART I DEVELOPMENT OF ANALYTICAL FRAMEWORK

1.1 INTRODUCTION

The domestic production and marketing of automobiles and light trucks occupies a dominant position in the United States economy. The industry is especially notable for three factors: its size, its concentration in four large corporations, and the growing interrelationship between the industry, the general economy, and the goals and policies of the people of the United States as expressed by their government.

An area of increasing concern among the members of the industry and the various regulatory bodies of the government has been the problem of understanding and projecting the future effects of proposed regulation in such areas as vehicle safety and fuel economy. Mandated changes in the type of vehicle produced, the way in which it is produced, and/or the way in which it is marketed are likely to have future effects upon the capital requirements of the manufacturers, the cost of their products, and the marketability of those products. The extent to which those future effects can be understood beforehand will have an important bearing on the direction, efficacy and viability of the proposals for change.

The ability to understand these complex future effects on the part of the regulators is a critical determinant of their ability to develop appropriate regulations, restrictions and incentives for the industry. The industry itself should not be expected to provide this understanding; it must be developed and tested externally. The requirement, therefore, is for the development of an understanding of the basic operating and capital financial parameters of the microeconomic activity of producing and marketing automobiles and light trucks.

Having stated the requirement, one has stated the problem--the microeconomic activity of producing and marketing automobiles and light trucks is necessarily obscured within the overall activities of the companies which participate. This situation arises from two important

factors:

- 1) The microeconomic activity of producing and marketing cars and light trucks is obscured from direct understanding by the fact that the producers prepare financial reports on the basis of accounting principles and concepts which were never intended to reveal basic microeconomic truths, but were intended rather to keep track of investor's monies and interests.
- 2) The microeconomic activity of producing and marketing cars and light trucks is obscured from direct understanding by the fact that the producers prepare consolidated financial reports on the totality of their operations; in every case these operations include significant activities and assets which are not related to the domestic production and marketing of automobiles and light trucks.

The thrust of this study is to develop by analysis and example techniques by which the true microeconomic activity of interest can be better understood and tracked by means of the published financial reports of the major producers: American Motors Corporation, Ford Motor Company, Chrysler Corporation, and General Motors Corporation. The study has been directed at both of the obscuring factors noted above.

In this section of the report, the conceptual problems of financial accounting itself are discussed, with reference to the problem at hand, and the specific accounting and reporting policies of the companies of interest are examined. Additionally, the reports themselves are examined to determine the most appropriate accounts for analysis--those accounts which can meaningfully be disaggregated and analyzed to understand the underlying microeconomic reality. In Part II of the report, the results of an examination and analysis of relevant accounts are presented for each of the four major companies for each of the ten years 1967-1976.

1.1.1 OBJECTIVES AND BACKGROUND

a. General Objectives

An elementary but essential initial step in the analysis of the United States automobile industry was the development of an understanding

of the rules and regulations which frame the financial reporting practices of the companies concerned. This section will commence with a review of the background surrounding financial reporting in general; exploring its conceptual principles and difficulties of application. The remainder of the section will review the specific reporting practices of the major automobile manufacturers and their implications on the published financial results of those manufacturers. In addition, contrasts and comparisons will be made between internal and external reporting procedures and their implications for financial analysis, as there are significant differences between the ways in which corporations employ accounting principles and standards to direct and control internal operations, on the one hand, and to report results to interested external parties, on the other hand.

b. Conceptual Origins and Problems of Reporting Practices

As its core, financial accounting can best be thought of as a set of procedures and conventions designed to collect and report 1) the net worth of a business at a point in time (balance sheet), 2) the changes in financial position between two points in time (income statement), and 3) the flow of funds also between two points in time (funds flow statement). The distinction between (2) and (3) derives from the fact that almost all major business enterprises record their financial transactions on what is termed an accrual basis. This convention records events as they give rise to legal obligations against or towards the company, rather than at the time cash is actually received or paid. The funds flow statement is used to translate the income statement and balance sheet, which are prepared to present financial information on the accrual basis, into their cash implications, as the cash implications represent the most telling indicator of the short-term, day-to-day financial health of the enterprise.

Additional events not easily measured or recorded, but having significant financial implications for the company involved, are typically disclosed by notations appended to the financial statements.

From these basic reporting requirements, however, numerous complexities of interpretation and practical problems of implementation arise

as soon as one attempts to move beyond mere statement of the conceptual principles. The subsequent narrative of company-specific financial evaluation will be enhanced by a brief identification and discussion of the conceptual basis for the practical problems faced in financial reporting. The following concepts lie at the core of this subject.

1) Cost Concept

This seemingly innocuous concept, which holds that assets should normally be recorded at the price paid to acquire them, has become extremely controversial in recent years. The cause of this controversy has been inflation and its impact on published financial results; for example plant and equipment purchased in the 1930's would cost some multiple factor of its original cost to replace today. There has been concern that investors might be misled by the relative performance of two companies between which the only difference is the age of their assets. The information presented in Table 1-1 will serve to illustrate this problem.

TABLE 1-1. COMPARATIVE RETURNS OF TWO HYPOTHETICAL COMPANIES

	Company	
	<u>A</u>	<u>B</u>
Net Profit after Tax (from income statement)	1,000	1,000
Net Assets (from balance sheet)	10,000	12,000
Return on Net Assets	10%	8.3%

The return on net assets measure is frequently, but mistakenly, taken by investors to measure adequately the comparative financial performance of particular companies. The cost concept distorts comparative measure; while net profit may or may not be calculated in a comparable manner by two companies (as will be discussed later), it is inevitable that net assets are not recorded similarly by two companies because of timing differences in their acquisition. Thus, Company A's assets may be older and require replacement in the near future while Company B's assets may be relatively new.

Currently, a substantial body of opinion holds that the return on assets of most U.S. industries is

dangerously low if those assets are calculated at their replacement values. For the purpose of this study it is significant to note that regulation or legislation which leads to the replacement of productive assets can have the tendency to lower returns and/or increase product selling prices.

2) Money Measurement Concept

Numerous events of importance to investors are not disclosed to them on the financial statements of the concern. This results from strict application of the money measurement concept. This concept holds that only facts which can be measured in monetary terms must be disclosed. For instance, should a market research study determine that consumer preferences have shifted from, say, larger to smaller cars, this information is beyond the realm of financial reporting. Investors and analysts must look beyond the basic financial statements to locate such information.

3) Realization Concept

The realization concept holds that revenues are recognized (i.e. "booked") when goods or services are delivered and in an amount that is reasonably certain to be realized. This concept has greater relevance in some industries than in others. The aircraft and construction industries, having long production lead times, have problems with income recognition. The automobile industry has relatively little problems in this regard. Autos produced are inventoried until a clear order is established from either a customer or dealer and product is shipped and invoiced, at which time revenue is recognized.

4) Matching Concept

As revenues are recorded, all costs associated with these revenues should likewise be recorded in the same period. This is termed the matching concept. Two implications of this concept for the automobile industry should be noted. Provision for product warranty costs are made at the time the products are sold. Secondly, the matching concept conflicts with the conservative concept (see following) and the latter dominates: promotion or research costs associated with a particular model sold during the year will have been expensed as incurred.

5) Conservative Concept

The conservative concept anticipates all losses and

does not assume any profits. This concept is the principle behind the expensing of research and development costs before any associated revenues have been received. It tends to distort accurate financial measurement because it "front loads" investment costs associated with a particular project. Thus, a company may appear to be losing money when, in fact, it is establishing the base of future earnings. The early days of Xerox and Polaroid are illustrative of this condition. The reverse is also true, however: research or promotion costs may be worthless if the product is not accepted in the marketplace. The framers of accounting rules, faced with uncertainty, decided to err on the side of being conservative.

6) Consistency Concept

As will be seen later in this section, a company can legally use one of several different methods of recording the same transaction. However, this concept holds that the method chosen should be used consistently from one period to the next.

The practical problems which arise in interpretation and implementation of these basic concepts are many. The average investor or lay analyst, for instance, looks to reported earnings per share as an absolute number upon which he can rely in evaluating the performance of a particular company. The variability in methods, acceptable and legal, by which this number can be calculated results in a wide possible range depending on the alternatives selected. Table 1-2 illustrates some of the possible methods of calculation which can legally be applied.

Table 1-3 illustrates how, by taking two philosophically different approaches, both equally legal and acceptable, the resultant reported earnings per share differ by more than 50%. Table 1-4 shows how the differences between the two methods arise. There are two points to be drawn from this illustration. The first is that the conventions permit interpretations that change the sums substantially (note that the use of either last-in, first-out (LIFO) or first-in first-out (FIFO) - see later discussion - results in a difference of over \$1-million). The company can decide for itself which method it wishes to use. The second note to be made is that the conventions themselves change absolutely. Alternative treatments of research expenses are no longer available; all research

TABLE 1-2. SOME GENERALLY ACCEPTED METHODS OF HANDLING TRANSACTIONS THAT AFFECT COMPANY EARNINGS PER SHARE

<u>Transaction</u>	<u>Alternatives</u>
Revenue Recognition	<ol style="list-style-type: none"> 1. Before sale 2. At sale 3. After sale: <ol style="list-style-type: none"> a. Completed contract b. Percentage of completion c. Installment sales
Inventory Methods	<ol style="list-style-type: none"> 1. Specific identification 2. Simple average 3. Weighted average 4. Last-in, first-out (LIFO) 5. First-in, first-out (FIFO) 6. Standard costs
Depreciation Methods	<ol style="list-style-type: none"> 1. Straight line 2. Fixed percentage declining balance 3. Sum of the year's digits 4. Units of output 5. Sinking fund 6. Replacement cost
Subsidiary Operations	<ol style="list-style-type: none"> 1. Consolidate 2. Do <u>not</u> consolidate <ol style="list-style-type: none"> a. Equity basis b. Cost basis
Investment Tax Credit	<ol style="list-style-type: none"> 1. Year of acquisition 2. Throughout life of asset
Intangibles	<ol style="list-style-type: none"> 1) Capitalize or 2) Expense <ul style="list-style-type: none"> - Organization cost - Goodwill - Patents - Copyrights

Source: Latane, H. A. and D. L. Tuttle, Security Analysis and Portfolio Management, New York: 1970, p. 85.

TABLE 1-3. CONSOLIDATED INCOME STATEMENTS AND RESULTING EARNINGS PER SHARE BASED ON TWO DIFFERENT BUT ACCEPTED SETS OF ACCOUNTING TECHNIQUES

Item	Method A (Conservative)	Method B (Liberal)
Net Sales.....	\$ 240,809,200	\$ 243,924,600
Cost of Goods Sold.....	<u>201,287,300</u>	<u>199,248,200</u>
Gross Profit.....	\$ 39,521,900	\$ 44,676,400
Other Operating Income.....		<u>1,191,000</u>
	<u>\$ 39,521,900</u>	<u>\$ 45,867,400</u>
Selling, General, and		
Administrative Expenses.....	<u>24,210,700</u>	<u>26,468,300</u>
	\$ 15,311,200	\$ 19,399,100
Other Income (Expenses):		
Interest Expense.....	\$ (1,810,900)	\$ (1,873,400)
Net Income--Subsidiaries.....	538,900	
Amortization of Goodwill.....	(170,000)	
Miscellaneous.....	<u>(269,000)</u>	<u>(229,200)</u>
	\$ (1,711,900)	\$ (2,102,600)
Net Income Before Taxes.....	<u>\$ 13,599,300</u>	<u>17,296,500</u>
State Income Taxes.....	\$ 638,000	812,900
Federal Income Taxes--Deferred.....		348,900
Federal Income Taxes--Current.....	5,238,000	6,440,000
Charges Equivalent to Tax Reductions from:		
Investment Tax Credits.....	775,000	
Tax Loss Carryovers.....	<u>990,000</u>	<u>297,000</u>
	\$ 7,641,000	\$ 7,898,800
Net Income.....	<u>\$ 5,958,300</u>	<u>\$ 9,397,700</u>
Earnings per Share.....	\$1.99	\$3.14

Source: "What are Earnings? The Growing Credibility Gap," Forbes, May 15, 1967, pp. 28-29.

TABLE 1-4. SUMMARY OF DIFFERENCES BETWEEN EXAMPLE COMPANIES

Inventories		Acquisition Loss Carryovers
A uses last-in, first-out;	B uses first-in, first-out.	
Difference--\$1,196,500		
Depreciation		Taxes on Subsidiary Profits
A uses sum of the years' digits;	B uses straight line.	
Difference--\$253,100		
Research Expenses		
A charges as incurred;	B amortizes over 3 years.	
Difference--\$191,500		
Acquisition		Investment Tax Credits
A treats as purchase;	B treats partly as purchase, partly as pooling of interest.	
Difference (See next 3 items)		
Goodwill from Acquisition		Unfunded Pension Costs
A amortizes over 10 years;	B does not amortize.	
Difference--\$170,000		
Acquisition Depreciation		Retirement Allowances
A uses "larger" base in purchase;	B uses "smaller" base in purchase and pooling of interests.	
Difference--\$63,800		
TOTAL DIFFERENCE: \$3,439,400		

Source: "What are Earnings? The Growing Credibility Gap," Forbes, May 15, 1967, pp. 28-29.

expenses must now be expensed as incurred whereas earlier significant amounts of research expense could be capitalized. The problem centers on whether such outlays have future value: if a certain project is a failure then the expenditure is a write-off, while if a success it could have considerable future value. The difficulty or impossibility of making such determinations before the fact created the problem of measurement. The solution in this case mirrors the imperfection of the problem. The accounting principles which cause the concern about earnings credibility have become more and not less controversial since the time that this example was constructed (1967).

The financial reports of the automobile manufacturers are affected by all of the areas of discretion and interpretation discussed on the preceding pages, and the companies have evolved individual styles and approaches to dealing with these areas, as will be detailed later in this section. The basic microeconomic facts of automobile production, when viewed through the corporate financial statements of the manufacturer, can be developed only by careful examination of and adjustments for the accounting policies employed.

c. Corporate Taxation and Reported Earnings

Regardless of the latitude available to a company in selecting between various accounting methods for financial reporting, the Internal Revenue Service affects that latitude in a fundamental sense. As was mentioned earlier, financial reports are almost always based on the accrual concept. Thus, reported profits are not synonymous with cash flow. A company is, therefore, required to pay taxes when the basis of the calculation may not be represented by cash-in-hand. This cash flow problem is further exacerbated by subtle definitions of what is capital and what is expense. Maintenance of real property can appropriately be charged against income and thus will reduce taxes, but improvements to the same property must be capitalized--producing no useful deduction in the near term. The dividing line between the two (maintenance and improvements) is not always obvious. However, with corporate tax rates approximating fifty percent, the cash flow value of

being able to classify an item as expense can be considerable.

This problem was the main stimulus leading many companies to switch the basis on which they valued inventories from FIFO to LIFO. Prior to the recent experience of high inflation the FIFO method was adequate from a tax perspective and corporate management accepted the method's benign tendency to increase profits. However, with high inflation rates, the artificial increasing of profits became a problem because taxes had to be paid on mostly fictional (i.e. non-cash) earnings.

The requirement to report earnings and pay taxes on those earnings, and the natural inclination of corporate managers to minimize taxes by whatever legal means available to them, are critical determinants of the accounting and reporting policies employed by the automobile manufacturers.

d. Sources of Technical Rulings on Financial Reporting

Although publicly available financial information is incomplete, in many respects it remains the primary source of information for the analyst. To make best use of this source, the analyst must be cognizant of the authorities which shape the requirements and format of financial reports.

The Securities and Exchange Commission, created by an act of Congress entitled The Securities Exchange Act of 1934, was created to administer the laws which relate in general to the field of securities and finance and to seek to provide protection for the public in their security transactions. The informational requirements of this Act (and its predecessor, the Securities Act of 1933) stipulate that the following be available to any investor or potential investor:

1) Registration Prior to Sale of Stock

No company can sell stock or bonds to the public (as opposed to a private offering) without a registration statement being filed and a prospectus being made available to the investing public. The prospectus contains (at a minimum) certified financial statements and a description of the purpose of the offering--the uses to which the funds raised will be put.

2) Annual Reports

The SEC requires each corporation subject to the Act to file an annual report (Form 10-K). This report is subject to specific SEC information requirements and to provisions governing the form and content of the financial statements which must accompany the report. The 10-K should be distinguished from the annual report to stockholders, the form and content of which, with limited exceptions, are largely determined by the issuing company.

3) Quarterly Reports

Abbreviated quarterly financial data should be filed with the SEC on form 10-Q. It is usually so abbreviated as to be of little use to the analyst other than providing the necessary results of current operations.

4) Current Reports

A current report of certain specified corporate and financial events must be filed 10 days after the end of the month in which they occur. These events would include items of an extraordinary nature having a material impact on the financial position of the company.

The SEC is concerned with the sufficiency of information given by corporations to present and prospective security holders. It has the legal authority to prescribe types of information that must be made public and the manner in which the information is to be prepared, including accounting methods. With few exceptions, to date, the SEC has relied on the standards of accounting and auditing promulgated by the American Institute of Certified Public Accountants (AICPA).

The Accounting Principles Board (APB) of the AICPA was formed in 1959 and assumed the responsibilities of earlier committees on accounting procedure and on terminology. The APB was itself superceded in 1973 by the Financial Accounting Standards Board (FASB). This body concentrated its focus to distinguish between its work and the relatively new Cost Accounting Standards Board. The operative words are "Financial" and "Cost", the former being externally-oriented and the latter internal from a company's perspective.

The pronouncements of the APB and FASB have only indirectly the force of law behind them. Instead they are based on the self-policing rules of the AICPA; a role permitted them by the SEC which is not itself set by law. Except in cases in which formal adoption by the Institute membership has been obtained, authority of opinions rests upon their general acceptability. While it is possible to depart from these rulings, the burden of justifying the departure rests with the certifying accountant who adopts another treatment.

The FASB is the current body ruling on technical accounting procedures. To date it has issued a series of sixteen statements, the most relevant of which will be discussed in later sections. There is no reason to expect that the FASB will not continue this function, regardless of the SEC's tendency to become more active in setting standards: a role always available to the SEC and exercised through the issuance of Accounting Series Releases.

e. Summary

The chemist does not add new elements to a given compound without first understanding the properties of the original substance and the planned addition. Thus, as various government agencies would infuse new factors into the automobile industry it is important that industry finances be understood. Generally accepted accounting principles are the rules and regulations which frame this subject. Because of their interpretive flexibility it is necessary that the implication of the particular interpretation chosen be understood.

Having briefly outlined the principles on which financial reports are prepared, this section of the report will proceed to evaluate the utility of available financial information from the perspectives of both the need for and ability to obtain the data. Information which would be particularly valuable to making determinations of legislative impact on a company can also be critical competitive data. While a company might want to have such data made available for the former purpose they clearly are inhibited from doing so for the second reason. Additionally, certain key items of data may not generally be available even within a given

company, considering the scale and complexity of its operations.

1.1.2 METHODOLOGY FOR EXAMINING ACCOUNTING POLICIES

The project team reviewed form 10-K for each of the four major automobile manufacturers. The significant accounting policies of each company used in the preparation of these annual statements are appended by way of notes. These have been analyzed and summarized for each company.

Next the team developed an understanding of the policies used and their implications on reported financial results. The financial literature such as Journal of Accounting, Financial Executive, the financial press, and other publications were reviewed to understand the technical background to the various key policies. The APB and FASB rulings were also reviewed. The implications of the policies selected are discussed together with their impact on reported results.

Following this, the analysts contrasted the differences in methods used among the auto companies based on the foregoing analysis.

Next the project team explored the differences between internal and external reporting procedures of the auto industry. The former relied upon the project team's knowledge of the internal reporting system of manufacturing companies supported by information of individuals, such as consultants and analysts, familiar with the auto industry.

Finally, the analysts have reviewed each line item of the published financial statements and form 10-K's to determine whether it would be useful or not for providing a base input on measuring the impact of government regulation. The work has proceeded from the principle that each number reported represents the top of a "data tree" which is arrived at through successive levels of detail. The team has made judgments as to the utility of constructing the data tree in support of a given number, and reported the selection as well as the reasons for making the judgments.

The remainder of this section of the report describes in detail the progress and results of these analytical steps.

1.2 REVIEW OF ACCOUNTING POLICIES AND PROCEDURES

1.2.1 PUBLIC REPORTING POLICIES OF MAJOR MANUFACTURERS AND IMPLICATIONS ON FINANCIAL RESULTS

The annual Form 10-K for each of the manufacturers for 1976 has been reviewed to determine the reporting policies of the companies. We have also reviewed the changes made to these practices during the previous four years. The implications of the policies on reported financial results have also been reviewed, as discussed in this section.

a. Principles of Consolidation

1) Current Policy: General

The policies on consolidation are established by Accounting Research Bulletin (ARB) No. 51 and APB Opinion No. 18. The purpose of these policies is to present the results of operations and the financial position of a parent company and its subsidiaries (including foreign subsidiaries) essentially as if the group were a single company. The consolidation treatment is modified under the following circumstances:

- a) Controlling but less than 100% interest: all line items are merely aggregated and the minority interest deducted out from profits and net assets.
- b) More than 20% but less than controlling interest: line items are not aggregated but the proportionate share of earnings and net assets are included (APB No. 18).
- c) Less than 20% interest: the investment is recorded at cost and only dividends received are brought into revenues.
- d) Most importantly, ARB No. 51 permits exclusion of certain subsidiaries if the separate presentation of financial information concerning the particular activities of such subsidiaries would be more informative to shareholders and creditors of the parent company. This point is relevant to the auto companies, which have a number of financial subsidiaries engaged in automobile and dealership financings. Because the nature of manufacturing and finance companies are substantially different, they are not consolidated.

Where subsidiaries are consolidated all intercompany transactions are eliminated in order to present an accurate "one company" picture of results. It would be double counting, for instance, to record the sale of products from one subsidiary to another which are, in turn, resold to the public: with engines "sold" from the producing division to the auto sales division, for example, only one sale is recorded regardless of the number of internal transfers.

2) Company Specific Policies 1972-1976

- a) American Motors: AMC has followed the above consolidation policies for the years 1972-1976.
- b) Chrysler Corporation: Chrysler has followed the above consolidation policies for 1972-1976.
- c) Ford Motor Co.: Ford has followed the above consolidation policies for 1972-1976.
- d) General Motors: GM has followed the above consolidation policies for 1972-1976.

3) Implications on Financial Results

The financial results of nonconsolidated subsidiaries are included in the present companies as single line items. Income is recorded as "equity in nonconsolidated subsidiaries and associates." Table 1-5 shows the relative proportion of revenues, earnings and assets of nonconsolidated subsidiaries as shown in the financial statements for 1976.

The nonconsolidated subsidiaries are relatively unimportant to their parent companies with the exception of Chrysler. Chrysler's subsidiaries amount to approximately 38% of the parent's net assets, illustrating the importance of the finance subsidiary investment to this company. Earnings, however, are relatively less important; because of intercompany transactions it is difficult to measure the reality of this number.

b. Inventory Valuation

1) Current Policy: General

The principles behind reporting inventory valuation are established under ARB No. 43, Chapter 4. Inventories are defined as (a) raw materials to be applied in production of goods for sale (b) materials

TABLE 1-5. RELATIVE PORTION OF REVENUE, EARNINGS AND ASSETS OF NONCONSOLIDATED SUBSIDIARIES FOR FISCAL YEAR 1976

	(\$ millions)			
	<u>AMC</u>	<u>Chrysler</u>	<u>Ford</u>	<u>GM</u>
Revenues⁽¹⁾				
Total	2,315	15,537	28,840	45,189
Nonconsolidated	10 ⁽⁵⁾	N/A	1,016 ⁽⁶⁾	1,922 ⁽⁶⁾
% Not consolidated	-	-	4	4
Earnings Before Tax⁽²⁾				
Total	(34)	520	1,603	5,285
Nonconsolidated	- (5)	30	180	161
% Not consolidated	-	6	11	3
Net Assets⁽³⁾				
Total	227	1,977	5,721	12,692
Nonconsolidated	16 ⁽⁵⁾	751 ⁽⁴⁾	920	1,435
% Not consolidated	7	38	16	11

(1) Excludes nonconsolidated transactions.

(2) Taxes are a corporate obligation. Excludes earnings in nonconsolidated subsidiaries.

(3) Excluding investment in nonconsolidated subsidiaries.

(4) Contains realty corporations.

(5) Realty company only.

(6) Finance company only.

Source: Company 10-K reports, 1976.

in process of production and (c) finished product awaiting sale. Because of the matching concept inventory costs are charged against revenues at the time of sale, and not at the time of purchase. The bulletin stipulates that inventories should be valued at the lowest of cost or market value. The latter concept is not likely to be an issue for the auto companies.

Costing inventories presents a problem, however, for which there is no perfect solution. ARB No. 43 focuses on two aspects of the problem:

- a) The first problem concerns what constitutes cost. ARB No. 43 defines cost as "the sum of the applicable expenditures and charges directly or indirectly incurred in bringing an article to its existing condition and location." This definition, however, is too broad. Recommendations of the Cost Accounting Standards Board (CASB) were endorsed by the Internal Revenue Service and have become the standard of what constitutes cost. Full absorption as defined by the IRS regulations means that direct material, direct labor and certain items of indirect production costs must be included while others must not be included; another category is optional. Table 1-6 shows the different categories. While an attempt has been made by the CASB to rationalize the elements of cost, it remains, nevertheless, flexible because of the optional category.
- b) The second, and perhaps more troublesome, problem results when the specific identity of materials is lost between the time of acquisition and the time of sale. For instance, sheet steel is a commodity, undifferentiated one roll from another. In order to satisfy the requirements of the matching concept and relate applicable costs to a given sale, it would be a considerable administrative burden to track the actual cost of every piece of sheet steel as it is stamped, built into an automobile and subsequently sold. This problem has resulted in a three-way classification treatment being used to track the flow of costs. There are last-in-first-out (LIFO), first-in-first-out (FIFO), or average cost methods. The former, for example, assumes that the cost value of the last roll to be received is the value to be charged against revenues. The opposite is true for the second treatment and the third tracks a continuous average calculation treatment.

Against the problems resulting from the variations in what actually constitutes cost, the cash flow problem causes an even greater, more fundamental, difficulty. If the LIFO method is used, then balance sheet values are understated, while if FIFO is used, then cost of sales will be understated (in times of rising prices).

TABLE 1-6. EXPENSES INCLUDED, EXCLUDED OR OPTIONAL IN CALCULATING FULL ABSORPTION COST

<u>Included</u>	<u>Excluded</u>	<u>Optional</u>
● Repair expenses	● Interest	● Taxes other than income taxes
● Maintenance	● Research and development expenses	● Depreciation reported in financial reports
● Utilities	● Losses (casualty and capital)	
● Rent		
● Indirect labor and production supervisory wages	● Depreciation for tax purposes in excess of financial reporting	● Pension and profit sharing on current service costs (for mfg. payroll)
● Payroll taxes	● G&A expenses and salaries paid to officers which are incident to and necessary as a whole rather than just to production	● Other employee benefits (for mfg. payroll)
● Indirect materials and supplies		● Rework
● Noncapitalized tools and equipment		● Scrap and spoilage
● Quality control and inspection		● Insurance costs
		● Factory and administrative expenses and officers salaries incident to and necessary for production

Source: Cost Accounting Standards Board: Standard on Full Absorption Costing.

2) Company Specific Policies 1972-1976

- a) American Motors: AMC states that inventories are valued at the lower of cost or market value. Cost is determined on the FIFO basis. The method has been used for the years 1972-1976.
- b) Chrysler: Chrysler has followed the above inventory valuation policies for the years 1972-1976.
- c) Ford Motor Company: Ford values its inventories at the lower of cost or market. In 1976 the company changed its method of accounting from FIFO to LIFO for most of the U.S. inventories. The cost of the remaining inventories is determined substantially on a FIFO basis. The change to LIFO reduced net income in 1976 by \$81 million or 86¢ a share. If the FIFO method of inventory accounting had been used by the company, inventories at December 31, 1976, would have been \$166 million higher than reported. For the years 1971 through 1975 Ford valued its inventory at the lower of cost or market, with costs determined substantially on the FIFO basis.
- d) General Motors: Inventories are stated generally at cost, not in excess of market, with cost of substantially all domestic inventories on a LIFO basis. The cost of inventories outside the United States generally is on a FIFO or average cost basis. In the years 1972 through 1975 inventories were stated substantially by the FIFO or average cost method. Where FIFO was not used, market value, expressed as current sales price less distribution cost for finished product and replacement costs for other inventory, was used.

In 1976 GM adopted the LIFO method of valuation for substantially all domestic inventories. The change resulted in lowering inventories by \$299.5 million and earnings by \$144.4 million or \$0.50 per share.

3) Implications on Reported Financial Results

As can be seen from the Ford and GMC reported changes in practice from FIFO to LIFO, the method selected can have a significant impact on reported earnings and inventories.

ARB No. 43, however, states that the method used should be applied consistently. Ford and GMC have a substantial reason for changing the valuation basis. While material costs are rising, FIFO distorts reported results by overstating earnings. While on the surface greater earnings should be welcome they result in greater taxes. The latter

result in immediate cash expenses while "inventory profits" do not. This change in accounting method should be regarded as a nonrecurring event.

c. Depreciation and Amortization

1) Current Policy: General

The objectives of depreciation and amortization expenses are to charge against revenue the cost for utilization of certain fixed assets (buildings, plant, equipment and tooling) over the economic life of those assets. Two "generally accepted" methods are used:

- a) Straight Line Method: assumes a fixed relationship between utilization of assets and time. Thus, if an item of equipment has an estimated life of ten years, then the amount to be depreciated would be charged against revenue equally for each of ten years.
- b) Accelerated Methods: several accelerated depreciation methods are employed to reflect uneven revenue earning potential or necessary maintenance support over the life of the asset. Several calculation methods (double-declining, sum-of-the-year digits) used to charge greater amounts against the earlier year than the later. For instance, if the sum-of-the-year-digits (SYD) method is used to depreciate an asset of five years' life, one-third of the total would be depreciated in the first year, which contrasts with the one-fifth using the straight line method. The SYD is $5+4+3+2+1 = 15$ and the first-year charge $5/15$.

Two major problems exist with the calculation of depreciation in addition to the arbitrary nature of the calculation itself. The first problem is with the fact that the basis of the calculation is historic cost. Inasmuch as depreciation also serves to provide for the replacement of a company's assets, the provision based on historic cost will not be adequate to replace equipment whose cost has been increased because of inflation. Many companies have this hidden danger undisclosed in their financial statements (but see Replacement Cost). It should be noted, however, that a company's assets also appreciate in value and a depreciation charge is not reflecting economic reality.

The second problem results from the estimation of useful economic life. This is always arbitrary at best because of variations in equipment quality, operating conditions and maintenance programs. The IRS, however, has an interest in the methods used and has established estimated useful lives for certain classes of assets. Companies may use different methods of calculating depreciation for tax and financial reporting, but the tendency is to use the same method.

A final and related problem exists with regard to what expenditures should be capitalized and what should be expensed. The generally accepted principle is that assets with an economic life of two or more years and not held for the purpose of trading should be capitalized. However, the problem arises after an asset is placed into service: should costs of improvements be regarded as maintenance or as increasing the economic life of the assets? If the latter, then the costs should be capitalized but the dividing line is not always obvious.

2) Company Specific Policies 1972-1976

- a) American Motors: property, plant and equipment which is stated at cost is depreciated over the estimated useful lives of the assets. Assets being depreciated by the straight line method approximate 37% of the total depreciable assets. All other depreciable assets are depreciated by the declining balance method.
- b) Chrysler: property, plant, and equipment are carried substantially at cost, less accumulated depreciation. Depreciation is generally provided on an accelerated basis. The cost of special tools is amortized on a basis designed to allocate the cost to operations during the years in which the tools are used in the production process.
- c) Ford Motors: depreciation is computed using an accelerated method that results in accumulated depreciation of approximately 2/3 of asset cost during the first half of the assets' estimated useful life. The costs of special tools are amortized over the productive period of use.
- d) General Motors: depreciation is generally on an accelerated method which accumulates depreciation approximating 2/3 of the cost during the first half of the estimated lives of the property. The cost of special tools is amortized over short periods of time because the utility value of the tools is radically affected by frequent changes in the design of the functional components and appearance of the product. In 1974,

based on a periodic study of depreciation policies, the number of property groups were increased by establishing a separate group for each year's acquisitions within each classification of property. This modification has the effect of depreciating the cost of certain groups of property more nearly over the service lives of the assets.

3) Implications on Reported Financial Results

It is particularly difficult to relate depreciation and amortization charges to revenues in any given period: the relationship is so tenuous as to be of little measurement value. The problem, however, is that depreciation can have a distorting effect on reported financial results. The amount of this charge will vary with the level of capital spending, particularly if accelerated methods are used, and only indirectly with operations. The discretion permitted to report financial results on one basis and calculate taxes on another adds further confusion to the results displayed.

A company whose need is to report as much earnings as feasible will utilize the straight line method for financial reporting without worry for any tax cash flow problem. Thus, AMC is the only company that uses straight line depreciation to any great extent in financial reporting.

Another significant implication of accelerated depreciation calculation, apropos the auto industry at present, is that during a concentrated capital expansion program depreciation charges will be particularly high in relationship to the years following when capital spending declines and depreciation falls off even more rapidly. This is a type of multiplier effect and will be explored later in the company specific disaggregation.

d. Taxes on Income

1) Current Policy: General

Corporate income taxes at both the federal and state levels can be estimated at about 50% of income for the year. The significance of this charge on reported earnings is considerable and made all the more so by various aspects of the Internal Revenue Code which can alter the tax charged

to a company in any particular year. It is "after-tax profits" which are available for paying dividends and providing funds for reinvestment in business.

The government is a 50/50 partner in U.S. industry who modifies its share of profits to reflect various social and macro-economic policies. These modifications can alter the amount of the tax charge to an extent which causes considerable variation in after-tax earnings. The problems which give rise to the modifications stem from the following:

- a) Some transactions affect the determination of net income for financial accounting purposes in one reporting period and the computation of taxable income and income taxes payable in a different reporting period. The amount of income taxes determined to be payable for a period does not, therefore, necessarily represent the appropriate income tax expense applicable to transactions recognized for financial accounting purposes in that period. A major problem is, therefore, the measurement of the tax effects of such transactions to the extent to which the tax effects should be included in income tax expenses in the same periods in which the transactions affect pre-tax accounting income. An example would be: expenses or losses are deducted in determining taxable income later than they are deducted in determining pre-tax accounting income. For example, estimated costs of guarantees and of product warranty contracts are recognized for accounting purposes in the current period but are reported for tax purposes in the period paid or in which the liability becomes fixed.
- b) The United States Internal Revenue Code permits a "net operating loss" of one period to be deducted in determining taxable income of other periods. This leads to the question of whether the tax effects of an operating loss should be recognized for financial accounting purposes in the period of loss or in the periods of reduction of taxable income.
- c) Certain items includable in taxable income receive special treatment for financial accounting purposes, even though the items are reported in the same period in which they are reported for tax purposes. A question exists, therefore, as to whether the tax effects attributable to extraordinary items, adjustments of prior periods (or of the opening balance of retained earnings), and direct entries to other stockholders' equity accounts should be associated with the particular items for financial reporting purposes.

- d) Guidelines are needed for balance sheet and income statement presentation of the tax effects of timing differences, operating losses and similar items.
- e) The investment tax credit of 10% of the asset value is available at the time the asset is placed into service but could be considered applicable to the total period of service.

These problems are discussed and solutions formulated by APB No. 11 Accounting for Income Taxes, associated interpretations and by IRS rulings. The responses to these problems are given below:

- a) Interperiod tax allocation is an integral part of the determination of income tax expense, and income tax expense should include the tax effects of revenue and expense transactions included in the determination of pre-tax accounting income.
- b) Interperiod tax allocation procedures should follow the deferred method, both in the manner in which tax effects are initially recognized and in the manner in which deferred taxes are amortized in future periods.
- c) The tax effects of operating loss carry backs should be allocated to the loss periods. The tax effects of operating loss carry forwards usually should not be recognized until the periods of realization.
- d) Tax allocation within a period should be applied to obtain fair presentation of the various components of results of operations.
- e) Financial statement presentations of income tax expense and related deferred taxes should disclose (1) the composition of income tax expense as between amounts currently payable and amounts representing tax effects allocable to the period and (2) the classification of deferred taxes into a net current amount and a net non-current amount.
- f) The investment tax credit may be either deducted from taxes for financial reporting purposes the year in which it is allowable, called the "flow-through" method, or amortized over the life of the asset called the "deferral" method.

2) Company Specific Policies 1972-1976

- a) American Motors: Because of significant tax losses of recent years, AMC does not anticipate a cash outlay for income taxes in excess of tax expense over the next three years. Investment tax credits at September 30, 1976,

totals approximately \$21,000,000; this will expire at various dates through 1983.

- b) Chrysler Corporation: Effective January 1, 1975, reductions in taxes resulting from the investment credit provision of the United States Internal Revenue Code are being taken in the income at the time the related assets are placed in service. Prior to 1975, investment tax credits were taken into income over the estimated lives of the related assets. This method, which more closely relates income effects to investment decisions emphasizes the economic stimulation the investment tax credit is intended to produce.
- c) Ford Motor Company: Ford Motor Company follows the investment tax credit procedure as used by Chrysler. Prior to 1975, investment tax credits were deferred and amortized over the useful lives of the related assets. This was known as the deferral method rather than the flow-through method.
- d) General Motors: General Motors Corporation follows the procedure whereby the investment tax credits are deferred and amortized over the lives of the related assets.

3) Implications on Reported Financial Results

As was mentioned earlier and can be implied from the company policies, the implications of the various tax accounting regulations can be considerable. The following bear particular note:

- a) Due to the tax loss carry forward provision, it is not expected that AMC will pay or report any taxes within the next few years.

In 1976 Chrysler utilized tax loss carry forwards in both the United States and overseas to increase earnings by \$94.14 million or 29%. Chrysler has substantial tax credits that it can carry forward to reduce its tax liability of future years. At the end of 1976 these included:

- investment tax credits of \$25 million expiring in 1982 and 1983.
- foreign tax credits of \$83 million. These will expire in 1977 and 1978 and will therefore be lost unless earnings can be generated to utilize these credits.

- b) The tax loss carry back provision can show a return of taxes should a company report a loss. For instance, in 1974 Chrysler reported a net loss from continuing operations of \$41 million after taxes including a tax credit of \$78 million.

c) General Motors uses the "deferral" method for reporting the investment tax credit which tends to decrease reported earnings. Ford and Chrysler uses the "flow-through" method which tends to increase earnings because taxes are reduced by the full amount of the credit in the year it became available. For instance, Ford adopted the flow-through method in 1975 which has the effect of increasing earnings by \$95 million for that year. Earnings for 1975 before the effect of the change were \$227.5 million, so this change increased earnings by 42%.

e. Research and Development Costs

1) Current Policy: General

FASB No. 2 dealing with the proper accounting for research and development costs has been the subject of controversy between the accounting and academic professions, the former holding to the practical problem of determining what R&D projects have future value, and the latter arguing against the blanket refusal to recognize only minor deferrals of expenditure. This is an example of the conservative and matching concepts in conflict.

FASB No. 2 defines research and development as follows:

- a) Research is planned search or critical investigation aimed at discovery of new knowledge with the hope that such knowledge will be useful in developing a new product or service or in bringing about a significant improvement to an existing product or process.
- b) Development is the translation of research findings or other knowledge into a plan or design for a new product or process or for a significant improvement to an existing product or process whether intended for sale or use. It includes the conceptual formulation, design, and testing of product alternatives, construction of prototypes, and operation of pilot plants. It does not include routine or periodic alterations to existing products, production lines, manufacturing processes, and other ongoing operations, even though those alterations may represent improvements and it does not include market research or market testing activities.

The statement describes activities which should typically be included and excluded under the definition. Table 1-7 gives these recommendations.

TABLE 1-7. ACTIVITIES TYPICALLY INCLUDED OR EXCLUDED FROM RESEARCH AND DEVELOPMENT COSTS

<u>INCLUDED</u>	<u>EXCLUDED</u>
● Laboratory research aimed at discovery of new knowledge.	● Engineering follow-through in an early phase of commercial production.
● Searching for applications of new research findings or other knowledge.	● Quality control during commercial production including routine testing of products.
● Conceptual formulation and design of possible product or process alternatives.	● Troubleshooting in connection with breakdowns during commercial production.
● Testing in search for or evaluation of product or process alternatives.	● Routine ongoing efforts to refine, enrich, or otherwise improve upon the qualities of an existing product.
● Modification of the formulation or design of a product or process.	● Adaptation of an existing capability to a particular requirement or customer's need as part of a continuing commercial activity.
● Design, construction, and testing of pre-production prototypes and models.	● Seasonal or other periodic design changes to existing products.
● Design of tools, jigs, molds, and dies involving new technology.	● Routine design of tools, jigs, molds, and dies.
● Design, construction, and operation of a pilot plant that is not of a scale economically feasible to the enterprise for commercial production.	● Activity, including design and construction engineering, related to the construction, relocation, rearrangement, or start-up of facilities or equipment other than (1) pilot plants, and (2) facilities or equipment whose sole use is for a particular research and development project.
● Engineering activity required to advance the design of a product to the point that it meets specific functional and economic requirements and is ready for manufacture.	● Legal work in connection with patent applications or litigation, and the sale or licensing of patents.

Source: Financial Accounting Standards Board, Statement No. 2 - Accounting for Research and Development Costs

One final observation as to what FASB No. 2 defines as cost: materials, equipment and facilities costs used for a particular research and development project that have no alternative future uses are considered as research and development costs and not capitalized.

2) Company Specific Policies 1972-1976

All four companies reporting state that costs incurred for the research and development of new products and the improvement of existing products are expensed as incurred.

3) Implications on Financial Results

The implications of FASB No. 2 on reported financial results are major in two respects. First, the policy of expensing all R&D costs when incurred has the tendency to reduce return on assets in the earlier years and increase it substantially in later years as the benefits of the particular venture materialize. The auto industry is unusually affected by this policy. R&D expenses for a mature industry tend to stabilize and thus become neutral to the financial results. The auto industry, however, has experienced a major shift in product definition in recent years, forced by government regulations and market demand, which has resulted in an increase in R&D costs that will continue for the next few years. In the opinion of several industry sources this effort will establish a new product generation different in several material aspects from its predecessors. The cyclical styling alterations that characterized past products might be stretched out and the range of product offerings will narrow. Thus, the "abnormally" high R&D may continue for several years as this structuring takes place but will then start to become abnormally low. FASB No. 2 will then amplify the impact on company profits during the changeover.

The second implication can be inferred from Table 1-7, Activities Typically Included and Excluded from Research and Development Costs. The problem of stating exactly how an item should be viewed can cause significant differences of opinion in what should be expensed or capitalized. For instance, the design of tools, jigs, molds and dies

would be expensed if "involving new technology" but possibly capitalized if "routine." The ability to classify the same expense two different ways can have a significant impact, given the major expenditures involved in relationship to profits (see company analysis), on reported profits with regard to both intercompany and interperiod comparison.

f. Pension Plan Costs

1) Current Policy: General

The reporting requirements on the pension plan costs are stated in APB No. 8-Accounting for the Cost of Pension Plans. The opinion requires the following:

- a) A statement that such plans exist, identifying or describing the employee groups covered.
- b) A statement of the company's accounting and funding policies.
- c) The provision for pension cost for the period.
- d) The excess, if any, of the actuarially computed value of vested benefits over the total of the pension fund and any balance sheet pension accruals, less any pension prepayments or deferred charges.
- e) Nature and effect of significant matters affecting comparability for all periods presented, such as changes in accounting methods (actuarial cost method, amortization of past and prior service cost, treatment of actuarial gains and losses, etc.), changes in circumstances (actuarial assumptions, etc.), or adoption or amendment of a plan.

2) Company Specific Policies 1972-1976

The total pension plan costs for the year includes the costs of current service and the amortization of past service costs. The policy is to fund pension costs as they are charged to operations.

- a) American Motors Corporation. AMC adheres to the above procedure amortizing the past service costs over periods ranging up to 40 years.
- b) Chrysler Corporation. Chrysler follows the above policy but amortizes prior service costs over periods not exceeding 30 years.

- c) Ford Motor Company. Ford follows the above procedure and amortizes prior service costs over periods of not more than 30 years.
- d) General Motors Corporation. General Motors follows the above procedure amortizing prior service costs over periods not exceeding 30 years.

3) Implications on Financial Results

The most significant aspect of reporting for pension plan costs is the unfunded prior service liabilities facing the companies and the effect it will have on future profits. Unfunded prior service costs for the companies are as follows:

AMC	\$0.36 billion
Chrysler	\$2.0 billion
Ford	\$3.3 billion
GMC	\$7.3 billion

It is incumbent on the companies to fund these liabilities. AMC will take 40 years to meet its liability, while the other three have set a 30-year amortization program. It should be stressed that these costs are in addition to the annual charge for pension costs.

g. Reserves Applicable to Foreign Operations

1) Current Policy: General

FASB No. 5-Accounting for Contingencies has modified the reporting practices for contingent losses. The statement now holds that: an estimated loss from a loss contingency shall be accrued by a charge to income if both of the following conditions are met:

- a) Information available prior to issuance of the financial statements indicates that it is probable that an asset had been impaired or a liability had been incurred at the date of the financial statements. It is implicit in this condition that it must be probable that one or more future events will occur confirming the fact of the loss.
- b) The amount of loss can be reasonably estimated.

By "probable" the statement means "the future event or events are likely to occur."

2) Company Specific Policies 1972-1976

- a) American Motors Corporation. AMC does not have investments in overseas operations comparable in any degree to the other auto manufacturers.
- b) Chrysler Corporation. Until 1976 the Chrysler Corporation maintained an international operations reserve to absorb extraordinary losses due to exchange restrictions or other extraordinary risks. These risks may result from extremely adverse labor and economic conditions in some countries in which operations are maintained. This reserve was extinguished in December 1975.
- c) Ford Motor Company. In accordance with statements of Financial Accounting Standards No. 5 and 11, the 1975 financial statements were restated to eliminate the reserve for foreign operations. At this time the reserve was transferred to earnings retained for use in the business. The income statement was not effected because there was no charge or credit made in the reserve during 1975.
- d) General Motors Corporation. The general reserve applicable to foreign operations was established in 1954. There had been no change in this reserve since its establishment. In the first quarter of 1976, the corporation implemented the statement of Financial Accounting Standards Board on Accounting for Contingencies (FASB No. 5). Accordingly, the former general reserve applicable to foreign operations has been redesignated as an allowance for losses on foreign investments and the allowance adjusted to an amount considered sufficient to meet current estimates of the probable losses on foreign investments. A portion of the allowance has been reclassified to reduce the net carrying value of certain impaired property to its estimated recoverable value, with the remainder of the allowance being included in other liabilities. The corporation's foreign investments are reviewed on a continuing basis and the allowance for losses on foreign investments adjusted accordingly.

3) Implications on Financial Results

FASB No. 5 has tended to reduce the uncertainty surrounding reserves for contingent losses. Companies now have much less flexibility in establishing reserves when the underlying events are unlikely to happen. Thus, the statement has made the financial statements more reflective of known facts and not supposition: as such it represents an improvement.

h. Translation of Foreign Currencies

1) Current Policy: General

In Section 1.1.1b - Conceptual Origins and Problems of Reporting Practices, the difficulty of using the cost concept and how it is impacted by price level changes was discussed. These difficulties, however, are compounded when reporting on foreign operations. For instance, a company with a German subsidiary will have the additional problems of translating Mark currency transactions in dollars. The question then arises as to what exchange rates should be used. FASB No. 8-Accounting for the Translation of Foreign Currency Transactions and Foreign Currency Financial Statements establishes reporting policies this area. The following are the stated translation objectives of FASB No. 8.

- a) At the transaction date, each asset, liability, revenue or expense arising from the transaction shall be translated into dollars by use of the exchange rate in effect at that date, and shall be recorded at that dollar amount.
- b) At each balance sheet date, recorded dollar balances representing cash and amounts owed by or to the enterprise that are denominated in foreign currency shall be adjusted to reflect the current rate.
- c) At each balance sheet date, assets carried at market whose current market price is stated in a foreign currency shall be adjusted to the equivalent dollar market price at the balance sheet date (that is, the foreign currency market price at the balance sheet date multiplied by the current rate).

Table 1-8 shows the rates used to translate assets and liabilities. Revenue and expense transactions are translated at the average rates prevailing during the accounting period. Average rates used should be appropriately weighted by the foreign currency volume of transactions occurring during the accounting period. For example, to translate revenue and expense accounts for an annual period, individual revenue and expense accounts for each quarter or month may be translated at that quarter's or month's average rate. The translated amounts for each quarter or month then are combined for the annual totals.

TABLE 1-8. RATES USED TO TRANSLATE ASSETS AND LIABILITIES

	<u>TRANSLATION RATES</u>	
<u>ASSETS</u>	<u>CURRENT</u>	<u>HISTORICAL</u>
Cash on hand and demand and time deposits	X	
Marketable equity securities:		
Carried at cost		X
Carried at current market price	X	
Accounts and notes receivable and related unearned discount		X
Allowance for doubtful accounts and notes receivable	X	
Inventories:		
Carried at cost		X
Carried at current replacement price or current selling price	X	
Carried at net realizable value	X	
Carried at contract price (produced under fixed price contracts)	X	
Prepaid insurance, advertising and rent		X
Refundable deposits	X	
Advances to unconsolidated subsidiaries	X	
Property, plant and equipment		X
Accumulated depreciation of property, plant and equipment		X
Cash surrender value of life insurance	X	
Patents, trademarks, licenses and formulas		X
Goodwill		X
Other intangible assets		X
<u>LIABILITIES</u>		
Accounts and notes payable and overdrafts	X	
Accrued expenses payable	X	
Accrued losses on firm purchase commitments	X	
Refundable deposits	X	
Deferred income		X
Bonds payable or other long-term debt	X	
Unamortized premium or discount on bonds or notes payable	X	
Convertible bonds payable	X	
Accrued pension obligations	X	
Obligations under warranties	X	

Source: Financial Accounting Standard Board, Statement No. 8 - Accounting for the Translation of Foreign Currency Transactions and Foreign Currency Financial Statements.

2) Company Specific Policies 1972-1976

- a) American Motors Corporation. Current assets and liabilities of all foreign subsidiaries are translated at the rate of exchange in effect at the close of the period; property, plant and equipment is translated at historical rates. Revenue and expense accounts, except for depreciation, are translated using an average rate. Gains and losses on exchange adjustments are recognized currently. The effect of such currency translations, except for the \$5,000,000 devaluation loss in AMC's Mexican operations, is not significant.
- b) Chrysler Corporation. Chrysler also adopted the FASB No. 8 on foreign currency translation in January 1976. The effect of implementing this accounting procedure did not produce a result materially different from the accounting practices previously followed by the corporation. Accordingly, prior year financial statements have not been restated.
- c) Ford Motor Company. The translation principles established by the Statement of Financial Accounting Standards No. 8 were adopted by the company in 1976. The principal change from the policy followed in previous years was to translate foreign inventories at exchange rates existing when the inventories were acquired rather than at rates existing at the end of the period. It was not necessary to restate 1975 and prior years for the new principles of currency translation.
- d) General Motors Corporation. General Motors also adopted the new FASB procedure in the first quarter of 1976. The effect of the adoption of this statement in both the current and prior periods was not material, thus no restatement of prior years results was necessary.

3) Implications on Financial Statements

The implementation of FASB No. 8 has not materially affected the reported results according to the companies. It should be stressed, however, that a problem in the policy itself distorts the translated data. Assets and liabilities translated at historic exchange rates as shown in the preceding table will either overstate or understate the values translated depending on the movement of the particular foreign currency vis-à-vis the dollar. Thus, plant and equipment of an English subsidiary will be overvalued while that of a German subsidiary will be undervalued. The extent of this translation problem cannot be deduced from the company financials.

Another problem is with exchange gains or losses. These arise when current exchange rates are used to value liquid assets and liabilities (e.g., inventories and receivables) and the rate changes when these assets and liabilities are converted into cash. The following exchange rate gains and (losses) were recorded by the companies in 1976:

AMC	Not material
Chrysler	\$31 million
Ford	\$(49) million (including \$40 million from change to No. 8)
GMC	\$245 million (including \$80 million from change to No. 8)

i. Replacement Cost Accounting

1) Current Policy: General

The fundamental accounting concept most under challenge is the cost concept. The impact of inflation throughout the industrialized nations has caused considerable alarm and confusion for many reasons, not least of which is the investor's view of financial reports. The question has been increasingly asked, "what did the company really earn?" as the investor and analyst sought to neutralize the measurement impact of inflation. The search for the "true economic earning power" on the investing public's capital led the SEC to intervene in the financial disclosure area with Accounting Series Release No. 190. While the goals of the SEC have not been argued, almost everyone else concerned challenges the results obtained as being worthless because of the theoretical difficulties involved. General Motors in their 1976 Annual Report states, "it is management's view that the replacement cost data presented herein cannot be used to compute the effect of inflation on net income as reported." The report goes on to cite the SEC's own caveat:

"The Commission cautions investors and analysts against simplistic use of the data presented. It intentionally determined not to require the disclosure of the effect on net income of calculating cost of sales and depreciation on a current replacement cost basis, both because there are substantial theoretical problems in determining an income effect and

because it did not believe that users should be encouraged to convert the data into a single revised net income figure. The data are not designed to be a simple road map to the determination of 'true income.' In addition, investors must understand that due to the subjective judgments and the many different specific factual circumstances involved, the data will not be fully comparable among companies and will be subject to errors of estimation."

Indeed, the experience of other countries whose need is even more pressing than that of the United States--such as Great Britain--suggests that the goal may not be attainable for they have virtually abandoned their considerable efforts.

The problems stem from attempting to translate historic cost of inventories and total productive capacity into an estimate of their current replacement costs and the effect of the latter on cost of sales and depreciation. The effort must furthermore be made on a worldwide basis. The SEC set the following computation guidelines:

a) Inventories

Where a company has a rapid inventory turnover the first-in-first-out (FIFO) method is used to better reflect the value of inventories at the balance sheet date. This assumes that no major alteration in prices has occurred; adjustment for these alterations is necessary otherwise.

b) Equipment

Estimated replacement costs for equipment are calculated by escalating historic costs using acceptable indexes, published by government and private organizations (e.g., in the United States the Wholesale Price Indexes, published by the Bureau of Labor Statistics). The escalated values are further adjusted to reflect technological changes by testing, on a sampling basis, the indexed values of a broad range of assets with the known replacement costs of similar equipment which incorporates modern technology.

c) Building

The available published (e.g., Dodge) per square foot construction costs for various facilities classes (e.g., assembly, warehouse, administrative, etc.)

applied to the total square footage volume outside the United States. Where similarly reliable data may not be available, indexing techniques are used.

d) Special Tools

The replacement cost of special tools, which have a short productive life because of design changes to products produced by the tools, are calculated on the basis of applicable indexes.

e) Cost of Sales

The use of last-in-first-out (LIFO) in valuing inventories for financial reporting approximates replacement cost.

f) Depreciation and Amortization

The straight-line basis is used to calculate accumulated depreciation.

Needless to say, the above calculations are highly subjective in many respects. The appropriate index may or may not reflect the price level changes that are being tracked. The adjustments are especially subjective. Furthermore, any attempt to recognize the effect of replacing productive capacity on maintenance costs or productivity (Ford estimates \$300 million savings worldwide) are highly problematical.

Chrysler describes the problem particularly well in its 1976 Annual Report: "The replacement of productive capacity is a gradual process taking place over many years. The location and kinds of productive facilities that will eventually replace present capacity are not reliably predictable because of the many variable, and somewhat interdependent, determinants such as production methods, technological progress, product configuration, energy scarcity, the emergence of new materials, and other factors including inflation, government regulations and the relative importance of nonautomotive transportation modes. Until these factors are known, realistic replacement costs of today's capacity to produce and distribute are simply not determinable. Accordingly, the Corporation disclaims any implication or representation that the estimated replacement costs provided herein are necessarily indicative of the actual costs to be eventually incurred over the years ahead to replace current productive and distribution capacity."

2) Company Specific Policies 1972-1976

All companies except AMC reported replacement cost information based broadly on the above guidelines in their 1976 annual reports.

3) Implications on Financial Results

The replacement cost data is frequently shown by way of notes to the financial statements. Table 1-9 summarizes the data presented. The following should be noted:

- a) Ford's special tooling increased by 50% as opposed to Chrysler's 38% and GMC's 14%. This surprising increase in Ford's costs could indicate a less rapid write-off of the gross margin and longer replacement cycles.
- b) Inventories do not change much, reflecting the fast turnover in the industry.
- c) Net plant and equipment generally doubles for each of the companies. As one might expect in a mature industry, most of the basic plants and equipment is old. What is not available, however, and which would be particularly interesting, is the amount of adjustments for technology changes.

j. Line of Business Reporting

1) Current Policy: General

FASB No. 14 - Financial Reporting of Business Segments will take effect beginning for 1977 financial statements for the purpose of "assisting financial statement users in analyzing and understanding the enterprise's financial statements by permitting better assessment of the enterprise's past performance and future prospects." If this statement is followed and not effectively resisted by companies fearing disclosure of valuable competitive data, then a radical change in financial reporting will have taken place. Present SEC line of business reporting requirements are so conceptually lacking as to be of little analytical value (see Implications). While FASB No. 14 will leave much of the definition of what should be defined as an industry segment with management, it nevertheless suggests that the following factors be considered:

TABLE 1-9. REPLACEMENT COST INFORMATION (UNAUDITED)--GENERAL MOTORS, FORD, CHRYSLER

\$'s in Millions	GM		FORD		CHRYSLER	
	As of December 31, 1976		Historical Replacement		Historical Replacement	
Inventories % Increase	6,328	6,627 5%	4,356	4,520 4%	2,354	2,360 .3%
Plant and Equipment	17,492	36,715	9,820	19,700	3,545	7,980
Less Accumulated Depreciation	<u>11,883</u>	<u>25,235</u>	<u>5,690</u>	<u>11,900</u>	<u>2,340</u>	<u>4,910</u>
Net Plant & Equipment % Increase	5,609	11,480 105%	4,130	7,800 89%	1,205	3,070 155%
Unamortized Special Tools % Increase	652	745 14%	1,022	1,500 47%	471	650 38%
Net Productive Capacity % Increase	<u>12,589</u>	<u>18,852</u> <u>50%</u>	<u>5,152</u>	<u>9,300</u> <u>81%</u>	<u>4,030</u>	<u>6,080</u> <u>51%</u>
<u>For Year Ended December 31, 1976</u>						
Cost of Sales % Increase	38,031	38,111 .2%	24,936	24,996 .2%	13,625	13,750 .9%
Depreciation Expense % Increase	939	1,575 68%	590	880 49%	141	310 120%
Amortization of Special Tools % Increase	1,297	1,330 3%	431	560 30%	261	380 46%

- a) The nature of the product--Related products or services have similar purposes or end uses. Thus, they may be expected to have similar rates of profitability, similar degrees of risk, and similar opportunities for growth.
- b) The nature of the production process--Sharing of common or interchangeable production or sales facilities, equipment, labor force, or service group or use of the same or similar basic raw materials may suggest that products or services are related. Likewise, similar degrees of labor intensiveness may indicate a relationship among products or services.
- c) Markets and marketing methods--Similarity of geographic marketing areas, types of customers, or marketing methods may indicate a relationship among products or services. For instance, the use of a common or interchangeable sales force may suggest a relationship among products or services. The sensitivity of the market to price changes and to changes in general economic conditions may also indicate whether products or services are related or unrelated.

The industry segment concept is particularly elusive. The Board's own assessment is that "differences among enterprises in the nature of their operations and in the extent to which components of the enterprise share common facilities, equipment, materials and supplies, or labor force make unworkable the prescription of highly detailed rules and procedures that must be followed by all enterprises." As a result, a large degree of subjectivity is inherent in applying these new rules.

FASB requires the following financial information by business segment:

- a) Revenue
The basis of intersegment transfers should be disclosed.
- b) Operating Profit or Loss
The methods used to allocate expenses should also be stated.
- c) Identifiable Assets
These include assets used exclusively by the business segment and a portion of assets jointly used by two or more industry segments as allocated on a "reasonable basis." However, assets maintained for general corporate purposes and intersegment loans should be excluded.

- d) Aggregated Depreciation and Amortization
- e) Capital Expenditures

This information should greatly increase the investor's knowledge of the company concerned.

2) Company Specific Policies 1972-1976

The SEC's present line of business reporting requirements are less detailed than FASB No. 14. For instance, GMC in 1976 listed automotive products as a line of business within U.S. operations. This amounts to 93% of all U.S. business and obviously included passenger vehicles, trucks, and buses. Indeed, their own definition given in the annual report is that "General Motors is a highly integrated business engaged primarily in the manufacture, assembly and distribution of products powered by motors, principally transportation equipment, and considers itself to be in a single broadly defined line of business." (emphasis added)

3) Implications on Reported Financial Results

Line-of-business reporting does not, strictly speaking, reflect itself in the financial results of a company; rather, it explains the reported results in its business components. The present practice plainly does not accomplish this. GMC, for instance, is not simply in one business called "automotive" and several other peripheral activities. It is doubtful that their line-of-business interpretation given in the 1976 report would stand the tests of FASB No. 14. It is difficult to anticipate how the companies might interpret FASB No. 14, but assuming a rational application of the tests suggested, particularly those related to the nature of the products and markets, it appears likely that North America Automotive would be considered a business segment. The products and markets for trucks and buses are substantially different from that of autos.

Beginning, therefore, with the auto manufacturers' reports for 1977 it is hoped to see line-of-business information of greater value for the microeconomic analysis of the automobile industry.

1.2.2 INTERNAL AND EXTERNAL REPORTING

Earlier, this report described briefly the problems inherent in calculating cost. Because neither the concept nor measurement of cost is intuitive, it is necessary to understand in more detail the background of how cost is calculated in the context of the automobile industry in order to calibrate any subsequent statements regarding what is the "cost" of an automobile, tool, plant or engineering effort. Using the simplest example to illustrate, what should be the "cost" of a part purchased from an outside supplier for inclusion into an automobile? Should the cost be the price paid? Should it include the cost of purchasing, unpacking, storing, assembling, shipping and accounting? If so, how should these costs be measured? This problem becomes even more complex when the company designs and manufactures the part itself.

The following description of the costing process is a compendium of knowledge the project team developed about how the auto industry works in this regard. The manufacturers do not all work in exactly the same way, but considerable commonality does exist. Furthermore, the methods used sometimes change even within companies, and this description should be considered as a baseline explanation.

a. The Structure of Cost

Ultimately all costs should be expanded for the purpose of generating revenues. However, costs vary considerably in their relationship to revenues. The matching concept (described earlier), in particular, is difficult to implement. The following structure describes the cost of an organization.

1) Expense and Capital Costs

It is necessary to distinguish at the outset between those expenditures which are to be charged against revenues when incurred (expensed) and those which are to be deferred (capitalized). The matching concept guides this decision. From an accounting perspective, inventories are simply accumulations of cost which are being deferred

until included in (or "matched" with) a product sold. Similarly, expenses to purchase plant, equipment and tooling with an economic life extending beyond the financial year are deferred to be charged against revenue using prescribed depreciation and amortization methods over the life of the particular asset.

Clearly, it is not always apparent into which category an item should be assigned. The automobile industry is particularly prone to this definitional difficulty. Industry sources contacted in the course of this study referred repeatedly to the problems in determining whether an item should be expensed or capitalized, and the complexity added by the relationship between taxes and reported earnings. A critical question facing the manufacturers is this: at what point should the maintenance of equipment or tooling be considered to extend the life of the asset and thus be capitalized? It is usually to the advantage of the company to classify the item as maintenance and thus expense it as incurred, gaining the cash flow benefit of reducing taxes. Table 1-10 indicates the magnitude of this one definitionally uncertain item in relationship to earnings for the domestic automobile manufacturers.

It is obvious from Table 1-10 that maintenance, repairs and rearrangements and total capital expenditures (plant, equipment and tooling) can greatly affect the reported earnings. In periods of high earnings the tendency must be to assign marginal judgment items to the former category and in periods of low earnings, to the latter. The company's ability to manage earnings is facilitated when the relative numbers for M R & R and capital are so large.

2) Expense Classification

Expenses are classified into distinguishing categories such as materials, payroll, utilities, supplies, etc. These are further detailed to break down payroll, for example, into overtime and categories of nonproductive time such as holidays and vacation.

TABLE 1-10. MAINTENANCE, REPAIRS AND REARRANGEMENTS AND TOTAL CAPITAL AS PERCENTAGES OF REPORTED EARNINGS

(Based on 1976, \$ Millions)

	M R & R		TOTAL CAPITAL		AFTER TAX EARNINGS
	\$	%	\$	%	\$
American Motors	44	-	53	-	(46)
Chrysler	450	137	424	129	328
Ford	829	82	1,055	105	1,009
General Motors	2,452	84	2,307	79	2,902

Source: Company 10-K reports.

3) Cost Centers

Expenses are also identified by cost centers. Cost centers reflect the organizational structure to a given level of detail. Sometimes referred to as responsibility centers, they collect cost information by discrete functional units. Thus, the auto companies' costs are first tracked to activities such as engineering, marketing, manufacturing, administration and corporate management and their various subdivisions.

4) Product Costing

Calculating the cost of a given product is always a difficult task and the result is never absolute. Product costing methods are compromises that attempt to establish the cost of a given item under assumptions that are known to be flawed but represent the best practical choice available.

Manufacturing cost in the automobile industries includes direct material, direct labor and overhead. Service costs from outside the manufacturing area are charged to the using manufacturing department on a transfer price basis (see later discussions). With the exception of directly related service costs, expenses of selling, administration or engineering are not included in manufacturing cost. Actual costing is a practical impossibility because of the administrative burden, thus manufacturing companies use a technique called standard costing to calculate product cost. For operational control purposes cumulative actual costs are measured against these standards and the resultant differences, termed variances, are used to track performances. Periodically, usually once per year, the standards are adjusted to bring them into line with the variances. An examination of the components of product costs and how they are derived will illustrate the difficulty of measuring in absolute terms the cost of a particular product.

a) Standard Material

The standard material cost of a product is based on the quantities of direct materials that are deemed necessary (based on the bill of materials), on the average, to manufacture one unit of product, multiplied by pre-selected or standard materials prices.

Two problems emerge with this definition. First, the "average quantities of materials" may or may not permit an allowance for items which could be scrapped in the process of manufacture. Second, material prices have to be estimated for the future period over which the standard will be used in the measure: in periods of shortages or price uncertainty, this can be highly subjective.

b) Standard Labor Cost

Labor quantities (as measured by standard rising sheets) necessary, on the average, to produce one unit of product multiplied by the standard wage rate.

Problems with calculating labor quantities include deciding both how to set the available production time in a given work day and whether a proportion of the non-productive time be included. Furthermore, it is difficult to decide how standard wage rates should be set given uncertainties as to labor management.

c) Standard Overhead Cost

Standard overhead cost is the amount of factory overhead to be absorbed by the production of a unit of product.

While techniques have been established by the Cost Accounting Standards Board (see earlier discussion) for calculating overhead, it remains a subjective and inaccurate process. Table 1-11 (from G. Schillinglaw's Cost Accounting Analysis and Control) illustrates the problems of overhead allocation and calculation. (The above definitions were also taken from this source.) The following should be noted with reference to Table 1-11:

- The six departments or cost centers shown include three service (indirect) departments whose costs have to be allocated to the three production (direct) departments. Primary distribution of costs includes allocation of facilities and services common to all departments. While some objective measures can be used for this purpose they are, nevertheless, imperfect. For instance, building costs may be transferred on the basis of square feet, but this practice rarely recognizes fundamental differences between administrative and machinery facilities.
- Secondary distributions require allocation of service department cost to the production departments. But within that level, secondary distribution becomes considerably more

TABLE 1-11. BUDGETED OVERHEAD DISTRIBUTION SHEET USING SEQUENTIAL ALLOCATIONS

	Total	Service Departments			Production Departments		
		Buildings	Factory Administration	Equipment Maintenance	Machining	Welding and Plating	Assembly
Direct Overhead:							
Salaries	\$10,200	\$1,000	\$6,100	\$ 600	\$ 900	\$ 500	\$ 1,100
Indirect Labor	20,200	1,900	•••	5,100	5,700	2,500	5,000
Operating Supplies	2,600	600	700	400	400	300	200
Equipment Depreciation	1,500	100	100	200	800	200	100
Miscellaneous	1,640	200	500	300	275	75	290
Total	\$36,140	\$3,800	\$7,400	\$6,600	\$ 8,075	\$3,575	\$ 6,690
Primary Distributions:							
Electric Power	1,600	200	•••	40	1,000	100	260
Building Depreciation, Taxes, Insurance	2,000	•••	200	120	800	280	600
Total Factory Overhead	\$39,740	\$4,000	\$7,600	\$6,760	\$ 9,875	\$3,955	\$ 7,550
Secondary Distributions:							
Buildings		(4,000)	400	240	1,600	560	1,220
Factory Administration		\$8,000	500	2,500	1,000	4,000	
Equipment Maintenance		(8,000)	\$7,500	5,625	1,125		750
Allocated Totals			(7,500)	\$19,600	\$6,640		\$13,500
Normal Volume (direct labor hours)					6,000	2,000	12,000
Burden rate/direct labor hours					\$3.267	\$3.32	\$1.125

subjective. For instance, Shillinglaw recommends that factory administration be distributed on the basis of production department payroll. Assuming a linear relationship between administration costs and direct payroll is a convenient but imperfect solution to a problem which defies a complete answer.

- Having assigned all costs of the service departments to the three production departments, the table proceeds to calculate an overhead or burden rate for each department. Total allocated costs are divided by estimated normal volume of direct labor hours. This denominator called standard volume anticipates output for some future period.

d) Variances and Cost/Volume Relationships

The costing systems of the auto manufacturers are designed to identify variances between actual cost and standard.

Material and labor variances include price and usage. However, it is the volume variances which cause the greatest problems with calculating a true product cost. The problem stems from the fixed/variable nature of costs. In the foregoing table the burden rate of \$3.267 for the machining department is based upon 6,000 direct labor hours. Should the direct labor hours change, there would be an over- or under-absorption of overhead.

This calculation of burden rate can be refined by analyzing the machining department costs into fixed and variable elements. This refinement, however, is only a partial solution because the definition of what is fixed and variable is changeable by substantial changes in volume.

The problems illustrated here are for a one plant operation; in the complex multiplant environment of the major auto companies product costing problems become compounded. The increased number of service functions cause greater obscuring of "true" cost.

b. Profit Centers and Transfer Pricing

The various divisions of the major companies are designated as profit centers. This concept essentially decentralizes profit and loss responsibilities within the organization. However, in order to implement this concept in a highly integrated company such as, say, GMC, it creates additional costing problems.

The problem stems from setting an appropriate interdivisional transfer price for products shipped from one division to another. For example, how should the price of engines be set? Industry sources indicate that a variety of bases are used, including (a) standard cost, (b) standard cost plus proportions of variances, (c) cost plus profit margin, and (d) market. The problems of cost-based transfer price have been discussed earlier. However, the market price is often more difficult to set as the components of an automobile are not commodities and there is no widely based market in which an undifferentiated product is traded. Industry sources have indicated that some companies have requested supplier bids in order to determine a transfer price but this practice was increasingly resented by suppliers when subsequent orders were not forthcoming and eventually was halted.

The major complexity from the analyst's point of view is that each transfer further obscures product cost elements: the division which receives an engine records the cost as "material" and not material, labor and overhead. In one particular example observed, almost 80% of the product cost was considered "material," but was composed actually of major components which were transferred from other divisions. What is variable cost to the consuming division is, in fact, a combination of fixed and variable to the supplying division.

c. Relationship to Financial Reporting

These internal costing issues are irrelevant to the basic corporate financial statements. However, in the implementation of FASB No. 14 these issues will assume some considerable significance. The basis on which transfers are made, the structure of cost and treatment of variances will have to be understood in order to obtain any value from the statement. This following caveat from GMC's 1976 Annual Report, however, shows that any value will not be easily gained:

"The operations of General Motors are assigned to divisions or subdivisions; therefore, because of the high degree of integration, substantial interdivisional and intercompany transfers of materials and

services are made. Consequently, any determination of income by the classes of products or areas of operations shown above (each of which includes transportation equipment) is necessarily arbitrary because of the allocation and reallocation of costs, including corporate costs, benefiting more than one division or product."

The project team in researching this assignment reached the conclusion that the product costing difficulties of the industry are so complex that they might not be understood even if the companies were to open their records to inspection. In this regard issues of product cost can best be understood on a specific incremental basis: questions posed in the form of "what if" can be better answered than by the "landscape" approach to product costing. This will be explored in Part II under the section Alternative Approaches.

1.3 DEVELOPMENT OF AREAS OF FOCUS

1.3.1 OBJECTIVES

The published financial reports of the domestic automobile manufacturers necessarily obscure the basic microeconomic parameters and variables associated with the production and marketing of automobiles and light trucks, as discussed previously. Thus far this section of the report has dealt with the procedures, regulations and conventions which frame the manner in which the published reports are prepared and the degree of detail they contain. Given the overall objective of this project--the development of techniques and an information base whereby the microeconomics of automobile production could be understood and tracked through published financial reports--it is appropriate to examine the form and content of the statements themselves to assess initially the utility and practicality of detailed analysis of actual reported data.

The primary, most comprehensive, and most detailed source of financial information available to the external analyst investigating the domestic automobile industry are the reports each manufacturer is required to file annually with the Securities and Exchange Commission on Form 10-K. The approach taken in this study was based on the premise that the information contained in the 10-K is the aggregated summary level of a tree-like data base wherein each successive level of information builds upon and successively condenses and consolidates the information of the lower levels to arrive at the published 10-K information. Because of the traditional patterns of secrecy in this industry, there exists no one single source that could describe in detail the data elements of this tree (except, of course, the internal accounting and financial staffs of the companies themselves). It was the contention of the project team that, constrained to work externally, research in a broad range of related sources could disclose data elements which when joined together and analyzed would build the composite picture sought, albeit with variable degrees of accuracy and completeness.

Given that the focus is the microeconomic environment of North America automobile production (cars and light trucks under 10,000 pounds gross vehicle weight (GVW)) numerous "branches" of the data tree do not warrant further analysis for several reasons. The corporations involved are composed of multiple business units each of whose purpose is trading in a defined marketplace. In addition to these business units are several corporate functions whose purpose is overlaid on the former; although related inasmuch as they serve these units, the corporate functions are still independent of them. As an example, finance is a corporate function: the sources of money, the mix of debt and equity capitalization, the cost of capital and repayment schedules which concern the financial staff at General Motors are not traceable to, say, the Pontiac Division. Corporate financial strategies are sufficiently distant from business unit strategies to be considered distinct from the operations of the business itself.

Moreover, there are some items (discussed later) which while undoubtedly useful for the present purpose, do not lend themselves to dissection without the active cooperation of the companies concerned. These items could not be pursued in the interest of practicality. Other items, while perhaps of interest in general, clearly have little urgency to the information requirements of Transportation Systems Center (TSC). Thus, setting priorities on items to be pursued was a joint project team/TSC effort based on discussion of what was practical and within the scope of TSC's own research efforts.

1.3.2 FINANCIAL DATA UTILITY EVALUATION

The financial data utility evaluation is based on a line-by-line review of Item 10--Form 10-K: Financial Statements and Exhibits. The review was undertaken to assess the value of the particular summary items for the purposes of this study, subject to the preceding constraints.

a. Income Statement

1) Net Sales

TSC has commissioned a separate study to analyze the revenue

structure of the auto companies; for this reason the composition of this account was not pursued here.

2) Equity in Earnings of Nonconsolidated Subsidiaries

The earnings of nonconsolidated subsidiaries are an element to be considered in the microeconomic analysis of the North American automobile industry, as the financing and realty subsidiaries derive most of their earnings from auto related activities. The sources of these earnings are division related, but the project team knew of no way, other than direct correlation with division revenues, that it might be analyzed further. The item is not of great significance (See Section 1.2.1 a) and was not pursued further.

3) Other Income Less Income Deductions

Each company displays this item with minor modifications. It contains the following:

a) Interest Received and Paid

This item is a component of corporate finance and is discussed under the balance sheet financial elements.

b) Gains or Losses on Foreign Exchange

This item is unrelated to the subject of this study. (See Section 1.2.1 h)

4) Cost of Sales and Other Operating Charges

The composition of cost of sales and other operating charges can only be deduced from information as to what this line item specifically excludes, and by what can be inferred. Table 1-12 shows a breakdown of this major income statement item. The account contains the following elements:

a) Product Cost

In the earlier discussions of the structure and nature of product cost the project team reviewed the complexity of this subject in a highly integrated manufacturing environment, which is worldwide in scope, such as that of the auto industry.

Problems exist with regard to analyzing this item for

TABLE 1-12. ANALYSIS OF COST OF SALES AND OTHER OPERATING EXPENSES

	(\$ millions)			
	AMC	CHRYSLER	FORD	GMC
<u>1972</u>				
Product Cost	1,124	7,818	15,043	20,875
R & D	30	191	621	880
M & R	<u>29</u>	<u>307</u>	<u>616</u>	<u>1,632</u>
TOTAL	1,183	8,316	16,280	23,387
<u>1973</u>				
Product Cost	1,382	9,576	17,541	25,070
R & D	33	247	826	1,018
M & R	<u>41</u>	<u>403</u>	<u>702</u>	<u>2,026</u>
TOTAL	1,456	10,226	19,069	28,114
<u>1974</u>				
Product Cost	1,657	9,346	19,108	23,939
R & D	35	239	825	1,125
M & R	<u>44</u>	<u>338</u>	<u>735</u>	<u>1,855</u>
TOTAL	1,736	9,923	20,668	26,919
<u>1975</u>				
Product Cost	1,967	11,279	19,678	27,075
R & D	37	199	748	1,114
M & R	<u>44</u>	<u>302</u>	<u>664</u>	<u>1,701</u>
TOTAL	2,048	11,780	21,090	29,890
<u>1976</u>				
Product Cost	1,945	14,289	22,741	34,321
R & D	39	280	925	1,257
M & R	<u>44</u>	<u>449</u>	<u>829</u>	<u>2,453</u>
TOTAL	2,028	15,018	24,495	38,031

Source: Company 10-K's.

the following reasons:

- Definition: although a standard exists to define what should or should not be included in product cost an optional category leaves exact definition open. (See Table 1-5)
- Measurement: the cost measurement procedures used in the industry are oriented towards operations control. Because of the highly complex, integrated and geographically dispersed nature of the auto industry, it is particularly difficult to calculate the cost of a certain product...even with inside information. (See Section 1.2.2 c)

A measure of the difficulty in developing product cost is that leading industry Wall Street analysts either are unable to calculate or misinterpret the operations costs. One report reviewed by the project team included research and development in factory overhead. Variable cost included full factory operating expenses regardless of their basic fixed/variable nature. Additionally, in this report non-automotive costs were also included with factory overhead and indirect expenses. Data reviewed that was even closer to the industry was no more detailed than that found in the 10-K.

For these reasons the project team determined that little additional reliable information or insights* could be gained by external analysis of this item.*

b) Research and Development

The research and development expenditures of the automobile industry are affected significantly by legislated product changes. To a certain extent, the industry is also willing to disclose the effect of mandated changes in this area. This item was also analyzed by the project team.

c) Maintenance, Repairs and Rearrangements

Maintenance, repairs and rearrangements (MRR) does not, on first appearance, seem to be an item affected by legislation. However, because of the definitional problem explained earlier (Section 1.2.2 a) it can

*While it is felt that little can be learned from published financial reports with respect to this item, nonetheless it remains an important item for examination, assuming an appropriate methodology and information sources can be developed.

sometimes be a matter of judgment only which determines whether a tooling or equipment item should be classified as MRR or capitalized.

For this reason the project team analyzed annual MRR expenses for each company.

5) Depreciation and Amortization

Depreciation and amortization costs are directly related to capital expenditures for (a) property, plant and equipment and (b) special tooling. These items are affected significantly and directly by legislation. Furthermore, inasmuch as the capital expenditures themselves can be analyzed the depreciation and amortization charges follow closely. This item was also analyzed.

6) Other Operating Costs

Form 10-K income statements list the following additional categories of cost:

- a) Selling and administrative expenses
- b) Provisions for incentive compensation
- c) Pension plans
- d) Interest expenses
- e) Taxes

The project team does not consider that the above would be directly and significantly affected by legislation, and thus they remain outside the scope of this report. However, the following exceptions should be noted:

- a) Selling expenses as a percent of sales could increase with a trend towards smaller cars if the present effort is focused on unit volume. This second level effect is difficult to predict because the companies would presumably attempt to adjust their marketing strategies. As the study is concerned primarily with data gathering and analysis, and not with interpretation of possible strategic actions, this item was considered low priority.
- b) The Employee Retirement Income Security Act (ERISA) has added a considerable burden to corporate pension costs. However, this

legislation was not concerned with automotive design or production per se, and was thus not pursued by the project team.

- c) Interest costs are affected by automotive legislation. Increased capital expenditures, to the extent not financed by internally generated funds, will give rise to increased borrowing and/or equity. The company's ability to borrow and the price it must pay for funds is a corporate level issue and can only be derived from the aggregation of the company's plans and prospects. A prior study for TSC focused on the financial structure of the auto industry, analyzing the debt capacity of the major automobile manufacturing corporations. In view of the earlier work the project team has not analyzed this item.

b. Balance Sheet

1) Working Capital

Working Capital is comprised of current assets less current liabilities. The former are assets which will be used to manufacture product or otherwise liquidated within the twelve months following the date of the balance sheet and the latter are liabilities which must be met within the same time frame.

The relationship between working capital and government legislation is minor and was not pursued by the project team. The relationship would be a speculative derivation based on estimated volume changes resulting from the impact of legislation on consumer demand.

2) Property

This item includes (a) real estate, plant and equipment and (b) special tools. These capital assets of the business are the items most directly affected. The project team has made this a primary area of analysis by attempting to understand the amounts expended by companies over the period of interest, focusing on North American automotive expenditures.

3) Notes and Exhibits

The notes and exhibits to the financial statements were used by the project teams to analyze and amplify the income statement and balance

sheet items of interest; beyond the issues raised earlier in this report they do not warrant analysis per se.

This is not meant to minimize the value of the notes and exhibits, for they are the first source of explanation for the items selected for further pursual. For example, a detailed component breakdown of property, plant and equipment is given in the notes and exhibits, while this account appears on the balance sheet only in summary form.

1.3.3 SUMMARY OF ACCOUNTS TO BE PURSUED AND THEIR SPECIAL CHARACTERISTICS

The remainder of this report will be concerned with the analysis on a company-by-company basis of the following items:

a. Income Statement

Items charged against income which were analyzed by the project team are:

1) Research and Development

Research and development costs are directly affected by legislative change. FASB No. 2 contradicts the matching concept in favor of the conservative concept by expensing all costs associated with R&D when incurred. This amplifies the impact of legislation by "front loading" costs before any benefits result. (See Section 1.2.1 e.)

2) Maintenance, Repairs and Rearrangements

Usually an insignificant cost item in the financial analysis of a manufacturing company, maintenance, repairs and rearrangements assumes an unusual significance in this instance given the large amounts involved in relation to tooling costs and the relationship between the two. (See Table 1-10.)

3) Depreciation and Amortization

Directly related to capital expenditures for plant and tooling, depreciation and amortization follows in a pattern determined by the companies. While less immediate in its impact than R&D, depreciation and amortization are also affected by legislation. (See Section 1.2.1 c.)

b. Balance Sheet

Items capitalized which were analyzed by the project team include:

1) Property, Plant and Equipment

The auto industry is relatively noncapital intensive. Domestically it is a mature industry in which the fixed assets tend to be in place; increases tend to be for replacement of obsolete equipment.

The level of spending is therefore sensitive to legislative changes because the incremental investment required by mandated charges can be high relative to the ongoing spending.

2) Tooling

The auto industry is marked by major and recurring expenditures for special tooling. Styling changes require constant reinvestment in tools and dies. Because these capital costs are amortized over the life of the car model produced, they are amortized rapidly and impact the income statement directly and significantly.

PART II HISTORICAL FINANCIAL DATA

2.1 INTRODUCTION

In 1976, the four domestic automobile manufacturers accounted, as corporations, for sales revenues approaching \$100 billion. While a substantial portion of these revenues was derived from the North American production and marketing of automobiles and light trucks, significant revenues were derived from other operations, either international automotive, nonautomotive or automotive as defined by the industry but not of interest for the purposes of this study (e.g., trucks with a GVWR over 10,000 pounds).

Part I of this report described the process and results of an analysis of the financial accounting and reporting policies, practices and regulations which affect the manner in which critical information about the corporation's activities is presented to (or hidden from) the interested external analyst. This part of the report will present the results of financial data analysis of the corporate reports of the major manufacturers for the years 1967-1976. As noted at the conclusion of Part I, analysis of the corporate reports along any dimension is difficult, prone to individual judgment, and therefore eminently arguable. The following simple example will demonstrate the problem.

For the purpose of establishing gross relationships of size and scale between the individual manufacturers, the project team felt it would be worthwhile to develop a table of components of corporate revenue for each of the major companies and in total, limiting the analysis to a single year--1976. While detailed revenue analysis is beyond the scope of this project, this exercise was considered appropriate and useful. Especially heartening was the consideration that Form 10-K requires geographical and business segment breakdown of revenue for any component accounting for more than 10% of the corporate consolidated total. Table 2-1 presents a compilation of these accounts based on the company 10-K's.

TABLE 2-1. REVENUES OF DOMESTIC MANUFACTURERS-ESTIMATED
COMPONENTS 1976 (\$ BILLIONS)

<u>Manufacturer</u>	<u>North American Automotive</u>	<u>International Automotive</u>	<u>Other</u>	<u>Total</u>
AMC	1.6	0.2	0.5	2.3
Chrysler	9.7	4.4	1.4	15.5
Ford	18.6	7.9	2.3	28.8
GMC	36.1	8.6	2.5	47.2
	—	—	—	—
	66.0	21.1	6.7	93.8

Source: Company 10-K's; ADL estimates.

The only amounts on this table which can be considered completely accurate are the Total column and the Ford Motor Company entries. Each of the other companies has interpreted the reporting requirement differently or provided additional, obscuring data.

- 1) AMC does not report international automotive revenues as they amount to less than 10% of the corporate total; the estimate was made based on reported unit sales.
- 2) Chrysler prefers to make two discrete cuts, separating automotive from all other and separating international from U.S. and Canada, both in terms of the total, leaving it up to the analyst to deduce the overlap and thus develop comparable data; the estimate shown has done this by finding, elsewhere in the Chrysler 10-K, an assertion that international automotive approximates 30% of total automotive.
- 3) GMC provides a detailed break-out of these accounts, but presents the results before intercompany eliminations, leaving it to the analyst to subtractively allocate \$5.2 billion of double-counting; the estimates presented result from this reallocation, based on analysis of unit sales and company market shares. (It is worth noting that GMC's intercompany sales are more than double AMC's total corporate revenues.)

This brief example was intended by the project team to demonstrate several crucial points to be observed as this section of the report is read. Primary among these is the fact that all of the numbers of interest developed by the analysis are estimates; none of them derives by pure arithmetic from published 10-K data. Secondly, but equally important, is the fact that the estimates are in every case based on the relationship of two sets of elements: the input numbers and additional facts and assumptions. While there is no question that alternative assumptions can be made or different relationships asserted, the project team has presented only those results for which there is sufficient rational evidence to provide confidence to proceed. The numbers are clearly arguable; but they are best considered bases to be argued from, rather than assertions to be argued against.

2.1.1 OBJECTIVES

The objectives of the financial analysis undertaken in this project were to provide disaggregated financial data for the U.S. automobile manufacturers which would lead to a better understanding of the micro-economics of automobile production and to provide by example analytical tools and techniques by which other analysts and investigators could better interpret published financial reports of the automobile manufacturers in terms of the microeconomic activity of interest.

In more specific terms, the financial analysis focused on the accounts identified in Part I with the objective of developing, for each of these accounts, the estimated values associated solely with the North American production of automobiles and light trucks. These estimates were to be developed for each of the four major manufacturers for each of the ten years 1967-1976.

An additional objective framing the approach and methodology of the project was that of developing the requisite information solely through external information sources, i.e., published accounts and reports, with the expectation that thus limiting the range of inputs available would increase the utility of the techniques developed for subsequent analysts.

In concert with these objectives was the additional requirement that the results achieved comprise part of a financial data base for the analysis of the U.S. automobile manufacturers, especially as these manufacturers are required to modify their product lines, production processes, and marketing strategies as a result of government legislation or regulation.

These objectives, requirements and constraints were jointly responsible for shaping the methodology of analysis, the sources pursued, and the report structure adopted, as described in the remainder of this section.

2.1.2 METHODOLOGY

The basic methodology for the financial analysis conducted was one

of successive disaggregation of individual accounts. Essentially, the disaggregation process consisted of making sequential factorings of an aggregated account to arrive at an estimate of the component of interest. The rationale for each successive factoring was developed from analysis of the relationship between the account of interest, other accounts, and external facts and items of evidence which could be used to develop defensible factoring assumptions.

The sources used in this process were essentially equivalent for each manufacturer. The primary source for the initial account balances was the Form 10-K report of each manufacturer for each year. All other sources were used primarily to develop factual information to aid in the successive factorings of the disaggregation process. These information sources included:

- a) Annual Reports to Stockholders (all companies, all years)
- b) Published news reports of company activities and events
 - Automotive trade press
 - Financial press
- c) Government hearings, proceedings and investigations of industry activity
- d) Informal discussion with retired industry managers and executives, financial analysts, and academicians

The Appendix to this report presents a complete list of published sources, a description of the source development project, and a discussion of the utility of the general data source areas.

The approach by which the data and information were incorporated into the overall methodology is best understood by a description of the structure of the historical data report for each company and the company narratives themselves. To describe the methodology in more detail outside the context of the results themselves would imply a rigidity and conceptual simplicity which the disaggregation exercise did not enjoy.

2.1.3 STRUCTURE OF HISTORICAL DATA REPORTS FOR EACH COMPANY

In the analyses that follow in this section of the report, a uniform format has been developed to frame the results for each of the four companies examined. Having reviewed the basic parameters within which the analyses were undertaken, as well as the conceptual approach pursued, it is appropriate to describe and discuss the report structure which was applied to the results for each company.

Within each company analysis the results are organized into six sections. The sections are concerned respectively with overall company size and scope, disaggregation of property, plant and equipment accounts; analysis of special tooling investments; analysis of annual maintenance, repair and rearrangement (MRR) expense; analysis of annual research and development (R&D) expense; and analysis of annual depreciation and amortization expense. The following paragraphs describe each of these structural components in detail with the objectives of:

- 1) Describing in greater detail the analysis methodology,
- 2) Discussing the generic problems of analysis in each area, and
- 3) Minimizing the necessity for repetitive explication of methodology and limitations in each company analysis.

a. Size and Scope

This initial section presented for each company is intended to provide a brief overview of the situation of each company. It deals primarily with total sales and the components thereof, business segments in which the corporation participates, domestic facilities (where available), and, where appropriate, specific comments as to data limitations affecting that company. As was discussed in Part I, individual corporations can and do exercise considerable discretion in the manner and detail with which financial results are reported. The result, for the analyst, is a frequently frustrating lack of consistency between the reports of different companies and an equally dismayng capriciousness of emphasis from year to year within a single company's reports. Given the automobile industry's traditional concern with

product, marketing and financial secrecy, it is not too much to assume that this lack of comparability and predictability is deliberate.

b. Annual Investments in Property, Plant and Equipment

In this section of the analysis an attempt was made to estimate with as much confidence as the data sources would allow the annual capital investments made by each of the manufacturers in the specific capital accounts of buildings, machinery and equipment. The focus of the analysis was to determine the investments made annually in these accounts devoted to the production of light trucks and automobiles in North America. As such it would be necessary to reduce the reported, worldwide consolidated investment figures as reported annually in the 10-K reports to eliminate:

- 1) Investments outside of North America
- 2) Investments not related to automotive (car and truck) production
- 3) Investments related to production of heavy trucks

Essentially the analysis proceeded by removing successive layers of investment, corresponding to the areas eliminated. As each layer was removed, increasingly judgmental decisions and allocations had to be made; while elimination of foreign investments could rely on published or acknowledged figures or ratios, elimination of nonautomotive investments required qualitative analysis of reported events and trends and assumptions as to the relationship of sales to investment, and finally elimination of heavy trucks (and bus) automotive investment relied heavily on individual judgment and industry rules-of-thumb. In the reported results for each manufacturer a narrative is presented to document the input facts, assumptions and judgments affecting each step of this process. It is important to remember that the data, information and published reports vary considerably between manufacturers. Thus, while the basic steps of analysis are identical for each company, the informational tools available within each step will differ to a significant extent. The approach adopted by the project team emphasized

the utility of pursuing each company analysis independently to the extent that the data available in that company's case would allow. This approach was believed to be consistent with the objectives of this project of developing tools and techniques of analysis as well as developing information itself. Therefore, while every attempt has been made to provide a consistent format of presentation of the results, there has been no attempt to impose an artificial consistency on the analytical paths followed to produce those results. The paths followed are fundamentally contingent on the data available for each company.

c. Annual Investments in Special Tooling

This portion of the company analyses was directed toward a disaggregation of investment similar to the property, plant and equipment analysis discussed above. That is, for each company an attempt was made to determine the annual expenditures devoted to purchasing or producing special tooling to be used in the North American production of automobiles and light trucks. As with the analysis of property, plant and equipment, the analytical approach adopted differed with each company; however, attempts have been made to allow as much comparability as possible through adoption of a consistent format for recording the results. One analytical approach which was thought to be potentially fruitful a priori, a "bottom-up" compilation of tooling expenditures through cataloguing and analysis of annual model changes and alterations, proved to be only moderately useful. Again the core of the problem rests in the basic incomparability of individual company cost reporting techniques. Additionally, published new release-type accounts of tooling expenditures for a particular model were found to be generally unreliable owing to their inclusion of non-tooling expenses or exclusion of critical cost or timing information. Thus, the primary use of the model change analysis was found to be in developing an understanding of the major influence on the trend of tooling expenditures, as opposed to explaining adequately the amounts actually expended. Owing to its limited utility, the model change analysis was not extended beyond the five years 1972-1976.

d. Annual Operating Costs for Maintenance, Repairs and Rearrangements

As discussed in Part I, the annual cost of maintenance, repairs and rearrangements comprise a significant expense category within cost of goods sold and in addition represent a considerable area of definitional uncertainty, providing manufacturers with discretion to declare a given expense as an operating cost as opposed to a capital investment.

For the automobile manufacturers, MRR expenses are essentially functions of three inputs:

- 1) The level of activity of the business--this will determine to some extent the amounts of maintenance and repairs which must be undertaken.
- 2) The level of capital spending--having more fixed assets requires generally more maintenance expense (however, repairs may decline as new equipment is purchased).
- 3) The product line activity--facilities must be rearranged when the type of product made or the production process itself is modified.

The individual company analyses present the reported MRR operating cost data for the manufacturers and proceed to analyze and explain the relationship of this cost to North American automobile production in terms of these three key variables. The approach is essentially qualitative as there was no published or available information which could be used to relate these variables quantitatively.

e. Annual Operating Costs for Research and Development

Research and development (R&D) expenses represent in some measure an area of discretionary spending on the part of the manufacturers. While R&D are clearly necessary to preserve and enhance competitive portion and to provide improved products, annual production of automobiles is not directly dependent upon R&D. Two additional significant parameters surround R&D spending. First is the realization on the part of manufacturers that R&D expenses are necessary to further compliance with government legislation, regulation and guidelines.

Equally important is the realization that R&D spending is constrained by the availability of talented and capable researchers. A manufacturer cannot simply decide to double his R&D efforts from one year to the next; time is required to develop the R&D capability. Conversely, while discretion does exist, R&D costs are primarily labor costs for R&D personnel and thus are to some extent fixed costs.

The company analyses which follow present consolidated R&D expense as reported, and then attempt to relate R&D to North American automotive by application of appropriate financial ratios. The details of approach taken for each company will vary somewhat; this variation will give an indication both of the difficulty of disaggregating R&D and the diversity of analytical techniques which can be applied against the problem.

f. Annual Operating Costs for Depreciation and Amortization

Depreciation and amortization expenses are directly related to previous capital spending for PP&E and special tooling, as such disaggregation to the level of North American automotive is a straightforward result of the capital investment analysis and assumptions as to timing. The key parameters surrounding this cost item, in terms of the manner in which it affects the finances of the automobile manufacturers, are the relationship of annual depreciation and amortization to current year's capital investments and the relationship of historical depreciation and amortization trends to trends in activity as measured by unit sales.

The project team analysts attempted to pursue these relationships by undertaking the following process:

- 1) Identification of consolidated corporate depreciation and amortization.
- 2) Estimation of North American automotive portion.
- 3) Comparison with previously derived PP&E and tooling activity.
- 4) Comparison with trends in unit sales.

As with the other accounts, the details of approach taken for each company will differ. It is hoped that the resulting information will provide significant insight into the problem as well as its solution.

2.2 ALTERNATIVE APPROACHES

As part of the study undertaken, the project team devoted consideration to the several alternative analytical approaches which might be and/or have been pursued to achieve the overall objective of developing a better understanding of the microeconomics of North American production and marketing of automobiles and light trucks. This section of the report presents a brief review of the most viable alternative approaches, detailing the conceptual framework, data requirements, output information and inherent limitations of each approach.

None of the alternative approaches was considered for adoption during the course of this project; it was decided a priori to conduct this study as a disaggregation analysis. In the interest of balance, the approach used herein is also characterized in this section in the same dimensions as the alternatives.

It is not the intention of this section to rank or rigorously evaluate the alternative approaches. Rather, the objective here is primarily to describe the unique focus, requirements and uses of each approach.

2.2.1 AGGREGATION ANALYSIS

Aggregation analysis consists essentially of attempting to determine the significant revenue, cost, income and investment accounts through a "zero-based," bottom-up compilation of data elements. Thus, for example, revenues are developed by discovering the prices and volumes of products sold, costs are determined by manufacturing cost analysis of individual components and assemblies, and investments are estimated from the perspective of capital requirements to support the production volume. Clearly the primary data requirement for this approach is accurate, complete and consistent disaggregated data in these areas and projectable analogous data from other industries and sources. The expected output information from this approach will be

revenue, cost and investment data as they relate to the specific activity of interest within the corporation, and thus a better understanding of the microeconomies of that activity, free from the obscuring effects of other unrelated corporate activities and the inconsistency and flexibility of financial reporting.

The limitations of this approach are primarily the lack of complete and consistent data elements sufficient to provide the analyst with confidence in the results. Various attempts which have been made at this approach have been frustrated by the lack of data, but as yet no improvements seem to have been made in the availability of the data. This results principally from the vast scale and dispersion of automotive operations for the companies involved. The companies themselves have evolved and developed extremely complex and elaborate systems for collecting this data internally; it is unrealistic to expect that external analysts could efficiently duplicate this process, lacking as they do access to any of the critical control points. Another limitation resides in the fact that the results achieved, no matter how accurate and comprehensive the individual data elements, may have only indirect relevance to corporate decision-making in the area of interest. While there is little doubt that corporations do collect and report this information internally, it is not at all certain that corporation executives base their decisions directly or even in part on this type of data.

2.2.2 BREAK-EVEN ANALYSIS

The break-even analysis approach represents a way of determining the operating profitability of a business and potentiality of projecting the income effects of future changes in costs, investments and revenues. The approach is essentially to determine, for the area of interest, the annual fixed costs which must be liquidated by the revenue contribution of products sold, after deduction of all the variable costs of production and marketing. Having these data, the analyst can determine the unit volume at which the costs are exactly

liquidated--the break-even volume. Knowing the break-even volume at a given point in time could theoretically enable one to calculate profitability at that point in time, and the sensitivity of break-even volume to projected changes in costs, revenues or investments.

The critical limitations of this approach are the inability of external analysts to determine accurately the division of cost between fixed and variable, the existence within the corporation of semi-fixed or discretionary costs, the problem that revenue-producing units do not contribute equally to liquidation of fixed costs, and the fact that product mix flexibility can render projections of future profits relatively inaccurate.

Nonetheless, break-even analysis can be useful in helping explain how a corporation achieves a return, the relationships of various businesses within the corporation, historical variability in profitability, and projections of major cost, investment and volume impacts.

2.2.3 TRADITIONAL INVESTMENT ANALYSIS

Traditional investment analysis such as that undertaken by securities analysts and investors could comprise elements of the preceding two approaches, but the primary focus is directed toward understanding the current and future value of the corporations equity. To the extent that the corporations themselves are interested in maximizing the market value of this equity, it can reasonably be expected that investment analysis might be useful for developing insights into the corporate decision-making process. Investment analysis typically is the most wide-ranging of the techniques employed, primarily because it is interested in any and all information which might affect the future value of equity.

In this interest, however, lies the fundamental limitation of this approach: the investment analyst's focus is dominated by a future orientation and by a necessity of considering the corporation in total, in terms of all of its business and operations. Investment analysis

techniques are not particularly helpful in understanding historical results or in understanding a discrete subset of the corporation's activities. Additionally, the basic approach of the investment analyst tends to be to assert a norm, based on current expectations or market conditions, and then to analyze potential variances from this norm and their effects.

2.2.4 DISAGGREGATION ANALYSIS

The requirements and approach of disaggregation analysis are described in this report; essentially it consists of successive reduction of reported aggregated data (usually readily available) by examination in light of external information which can be used to characterize the data and segment it.

The principal limitation of this approach, as determined during the course of this study, is the lack of reliable, comprehensive and consistent information to bring to bear in the manipulation of aggregated data. Additionally, disaggregation analysis provides little or no insight into the corporate focus on the accounts analyzed; the corporations may or may not use this type of information to make investment, product and marketing decisions.

Finally, disaggregation analysis typically depends heavily on the judgment of the individual analyst as to the relationship between data and external information.

Nonetheless, the legitimate expectation of disaggregation analysis is that the method will provide referencable sources and analyses which can be asserted in the hope of producing increasingly accurate and relevant information.

2.3 COMPANY RESULTS

The following four sections present the historical financial data analysis for each of the companies investigated in the format discussed in the introduction to this part of the report. The individual company analyses are essentially discrete and can be read in any order. They are presented here alphabetically.

2.3.1 AMERICAN MOTORS CORPORATION

a. Size and Scope

American Motors (AMC) has consistently been the smallest of the four significant domestic automobile manufacturers over the period 1967-1976. For 1976 the total revenues of AMC were \$2.3 billion; the estimated North American automotive portion of these revenues was approximately \$1.6 billion (see Table 2-A1).

AMC's businesses are typically characterized by the company as general automotive, which includes passenger cars and utility and recreational vehicles, special government vehicles, including tactical truck, transit bus and postal service vehicles, and other operations, which includes plastic products and equipment and lawn and garden tractors. Principal nonconsolidated subsidiaries of AMC are American Motors Realty Corporation, all foreign operations with the exception of Canadian operations and an overseas sales subsidiary, and the company-owned retail sales outlets.

In summary, AMC's businesses can be listed as follows:

- 1) General automotive
 - Automobiles
 - Utility vehicles
 - Recreational vehicles
- 2) Special vehicles
 - Buses
 - Tactical trucks
 - Postal vehicles

- 3) Plastic products
- 4) Lawn and garden tractors and associated products

The business area upon which this analysis will concentrate is clearly that which AMC identifies as general automotive. While there are some products within the special vehicles segment, notably postal service light vehicles, which might be included in an analysis of automobile and light truck production, the problem of segregating these units from the total production of the government vehicle business was irresolvable. The total units involved are immaterial in any case.

The general automotive business for AMC accounted for 80% of sales in 1976 and produced an operating loss of nearly \$60 million. Table 2-A1 presents, from the 10-K of AMC for 1976, the components of revenue (it should be noted that AMC's fiscal years close on September 30 each calendar year).

TABLE 2-A1. AUTOMOTIVE SALES-AMERICAN MOTORS 1972-1976 (\$ MILLIONS)

	<u>1976</u>	<u>1975</u>	<u>1974</u>	<u>1973</u>	<u>1972</u>
General automotive sales	1,855	1,909	1,818	1,587	1,174
All other sales	471	390	205	160	239
Total sales	2,326	2,299	2,033	1,747	1,413
Automotive %	79.8	83.0	89.9	90.8	83.1

Source: Company 10-K reports.

North American automotive sales for AMC have averaged 87% of total automotive sales over this period, based on the unit volume relationships and the assumption that the exported products are equivalent to domestic products. For the purpose of this analysis, AMC's investments related to the automotive business will be considered totally as domestic production investments. Given the units involved, the shared production facilities, and the fact that foreign assembly

operations are not consolidated, geographical disaggregation of the investment accounts was not pursued. (In fact the amounts reported by AMC are totally North American; the fact that some portion of the investments supports export sales does not correspondingly suggest that the assets are severable.)

Physically, AMC's automotive operations are concentrated in the United States and Canada. There are three primary assembly plants, supported by component manufacturing, stamping and engine plants. The principal facilities are listed in Table 2-A2.

TABLE 2-A2. AMC PLANT LOCATIONS-AUTOMOTIVE

<u>Location</u>	<u>Function</u>
Kenosha, WI (2 plants)	Manufacture of components and bodies and final assembly
Toledo, OH	Jeep manufacture and final assembly
Brampton, Ontario	Manufacturing of bodies and final assembly
Milwaukee, WI	Body manufacture
So. Charleston, WV	Stamping
Richmond, IN	Engines
Sarnia, Ontario	Castings

Source: Moody's Industrial Manual

In summary, American Motors, in contrast with the other three domestic automobile manufacturers, comprises a small, narrowly focused, geographically concentrated manufacturer. The conceptual distance between AMC's consolidated annual report accounts and the amounts of interest to this study is shorter for this company than any of the other three. Two specific problems which must be dealt with, however, affect the analysis of early years (1967-1970). In 1968 AMC discontinued its Kelvinator appliance operation; this decreased sales volume by 25%. In 1970 the company acquired Jeep from Kaiser Industries,

which effectively increased the size of the corporation by 50%. The derived figures for the years 1967-1970, therefore, must be interpreted as less definitive than those for the years 1971-1976.

b. Annual Investments in Property, Plant and Equipment

Table 2-A3 presents the reported annual capital expenditures of American Motors on a consolidated basis for the years 1967-1976. These figures are taken from the annual 10-K reports, Schedule V-Property, Plant and Equipment. The column for Land summarizes land and land improvement, Buildings combines buildings and leasehold improvements with building equipment. Machinery and equipment and special tools are as stated. Figures have been rounded to tenths.

TABLE 2-A3. PUBLISHED CONSOLIDATED CAPITAL EXPENDITURES-AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Land</u>	<u>Buildings</u>	<u>Machinery and Equipment</u>	<u>Special Tools</u>	<u>TOTAL</u>
1967	-	0.7	2.3	35.5	38.5
1968	0.1	0.7	2.1	15.3	18.2
1969	0.6	2.6	5.5	38.0	46.7
1970	0.5	6.7	8.0	26.1	41.3
1971	-	4.3	9.8	13.5	27.6
1972	0.4	4.3	9.6	17.8	32.1
1973	-	6.9	18.0	43.5	68.4
1974	0.1	7.8	36.7	50.8	95.4
1975	0.1	7.3	37.3	44.7	89.4
1976	0.2	10.5	15.6	26.7	53.0

Source: Company 10-K reports.

One is struck immediately upon examining these figures by the variability in the total: from a low of \$18 million in 1968 to a high of \$95 million six years later. Another apparent observation from these data is the importance of machinery and tooling expense to the total and to swings in the total.

As discussed previously, the nature of AMC's businesses and the principles of consolidation the corporation pursues have the result that these investments can be considered wholly North American with adequate confidence. The essential disaggregation, therefore, was concerned with eliminating those items which were not related to AMC's automobile (and since 1971 Jeep) business. For the year 1967, 1968 and 1969, the fixed asset accounts (i.e., excluding tooling) can be considered as wholly devoted to domestic automobile production, as the Kelvinator operation was sold off in 1968. It is reasonable to assume that incremental investments in property, plant and equipment were not undertaken by AMC for the Kelvinator business during the year of disposition or the year immediately preceding disposition.

Thus, for the years 1967, 1968 and 1969 the disaggregating accounts for land and buildings and for machinery and equipment are assumed to be essentially identical to the aggregated accounts. For the years since 1970, an attempt was made to disaggregate the accounts by examination of the company annual report narrative for each year. In each year's annual report there appears a discussion of major events in the fixed asset accounts of the corporation. Analysis of these events provided an indication of the proportionate investment and nonautomotive areas.

The following discussion details the assumptions and findings of this analysis, as it pertains to the land and buildings accounts.

- 1) 1970: of the \$7.2 million additions reported in the (combined) "Land and improvements" and "Buildings" accounts, the project team was able to identify specific investments of \$3.0 million, of which \$2.6 million is considered automobile-related. The specific events identified are:
 - a) Replacement of an R&D facility at Detroit, disclosed cost \$1.5 million, assumed 100% auto-related (1970 annual report).
 - b) Expansion of Stratford, Ontario soft component facility, 105,000 square feet, estimated cost \$20/square foot (used throughout analysis), assumed 50% in 1970, resulting investment \$1.1 million all auto-related.

- c) Expansion of South Bend (tactical vehicle) operation, 34,000 square feet, 50% in 1970: \$0.4 million not auto-related.

The residual, \$4.2 million, was assumed to be 75% auto-related, based on discussions with industry analysts.

- 2) 1971: financial statement total of \$4.3 million, identified \$2.2 million of which \$1.8 million was considered automotive-related:

- a) \$0.8 million modification at Coleman, WI (50% of two-year project).
- b) \$1.0 million related to project begun in 1970 (Stratford).

The remaining \$2.1 million was assumed to be 75% auto-related.

- 3) 1972-1976: the analysis proceeded in this fashion for each year; for the more recent years the estimated totals based on examination of major events explained most of the reported amount each year. Table 2-A4 summarizes the analysis results. The residual unexplained investment for each year was allocated to automotive and non-automotive by the following criteria:

- a) Industry sources suggested \$0.7 million related to required changes for 1976 and 1975, all auto-related.
- b) 1976 annual report notes \$1.4 million construction in progress, all auto-related.
- c) The remaining amounts were considered 50% auto-related and assumed to comprise numerous capitalized small additions and modifications. Table 2-A5 presents the summary disaggregation of the Land and Buildings accounts based on the assumptions and analysis described.

TABLE 2-A4. ANALYSIS OF AUTOMOTIVE-RELATED INVESTMENTS IN LAND AND BUILDINGS, AMC 1972-1976

Facility Change	Estimated Timing (\$ millions)				Notes
	1976	1975	1974	1973	
A. AUTOMOTIVE					
1) Charleston, WV stamping plant expansion			0.5	0.5	Leasehold improvements
2) Coleman, WI component plant modification				0.9	Begun in 1971
3) Evart, MI plastic component plant expansion			1.9	1.9	
4) Iron River, MI component plant expansion				0.9	1.9
5) Kenosha, WI stamping plant modification	0.2	0.2	0.8		Timing inferred from annual report statements
6) Milwaukee, WI parts center expansion		2.0	2.0	2.0	
7) Richmond, IN engine plant	6.0				
8) Stratford, Ont. expansion		0.6	0.6		
	6.2	2.8	5.8	5.3	3.6
B. NONAUTOMOTIVE					
1) Marshall, TX bus plant				0.7	0.7
2) Mercury Plastics	0.3	0.5		0.3	
3) Mishawaka, IN bus plant			0.8	0.8	
4) Wheel Horse		0.4		0.4	
5) Windsor Plastics	1.0	1.0			
TOTAL NONAUTOMOTIVE	1.3	2.7	2.2	0.7	0.7
RESIDUAL	3.0	1.9	-	0.9	0.5
					See Table II-A3

TABLE 2-A5. LAND AND BUILDINGS INVESTMENTS ASSOCIATED WITH AUTOMOTIVE PRODUCTION, AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Reported Total</u>	<u>Estimated Amount</u>	<u>Automotive % of Total</u>
1967	0.7	0.7	100%
1968	0.8	0.8	100%
1969	3.2	2.9	90%
1970	7.2	5.8	81%
1971	4.3	3.8	88%
1972	4.7	3.9	83%
1973	6.9	5.8	84%
1974	7.9	5.8	73%
1975	7.4	3.8	51%
1976	10.7	7.7	72%

Source: Company annual reports and ADL estimates as described.

Several additional observations should be made concerning these data:

- 1) The analyst is struck by the particular small scale of the investments in relation to the annual fixed asset investments of the other manufacturers.
- 2) Since 1970, when the configuration of AMC became essentially what it is currently, the initial pattern of automobile-related plant investment was a fairly consistent 80-85%. The decline in this trend shown in 1974 and 1975 appears to be due primarily to AMC's increasing interest in special government vehicles (AM General) and plastics molding (Windsor Plastics).
- 3) Significantly more information has been disclosed by AMC concerning capital events in recent years as compared with the pre-1972 period.

The next area for disaggregation was that of machinery and equipment. Again AMC's consolidation policies made geographical disaggregation unnecessary; thus, the thrust of the disaggregation analysis was to eliminate those investments unrelated to automotive production.

An analysis and tallying of specific events, such as that undertaken for land and buildings, was not feasible in this area owing to an absolute lack of published machinery and equipment investment information. Confronted with this circumstance, the project team developed a set of estimating assumptions based on the following logic.

As noted above, it was determined that AMC would have been unlikely to make any substantial investments in their home appliance business during the two years of its existence with which this analysis is concerned (1967 and 1968). From 1969-1976, the sales revenue composition of AMC's businesses has been as presented in Table 2-A6.

TABLE 2-A6. SALES REVENUE COMPOSITION, AMC 1970-1976 (PERCENT)

<u>Year</u>	<u>General Automotive</u>	<u>Special Government</u>	<u>Other</u>	<u>TOTAL</u>
1969	76	24	-	100%
1970	77	23	-	100%
1971	79	21	-	100%
1972	83	17	-	100%
1973	90	9	1	100%
1974	90	8	2	100%
1975	83	15	2	100%
1976	80	17	3	100%

Source: Company 10-K reports.

The decline in special government vehicle sales over the 1969-1973 period was reported by the company to be a result of sharply decreased military procurement. It is unlikely to expect that additional incremental investment in machinery and equipment for these products would have been required; rather it is logical to assume that excess capacity was available. Thus, for the years 1967-1972, a derived factor of 90% was established to represent the automobile-related machinery and equipment investment. The remaining 10% was assumed to

account for replacement of assets for other businesses and investments in new businesses and projects.

During 1973 and 1974 AMC established AM General's position in the transit vehicle industry; this was done partly to develop stable markets for the government vehicle products and partly to provide new areas of growth for the corporation. It is reasonable to assume that during these years there was incrementally higher investment in machinery and equipment for this new business area. Thus, for those two years a factor of 75% for automobile investments was established.

Finally, during the last two years of the analysis, 1973 and 1976, the substantial investments requirement in the Richmond, Indiana engine plant, combined with an assumption that a transit bus productive facility had been adequately established, led the project team to return to a 90% factor. The factors and resulting disaggregated amounts are presented in Table 2-A7.

TABLE 2-A7. MACHINERY AND EQUIPMENT INVESTMENTS ASSOCIATED WITH AUTOMOTIVE PRODUCTION, AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Reported Total</u>	<u>Derived Factor</u>	<u>Estimated Amount</u>	<u>Index</u>	<u>Adjusted Amount</u>
1967	2.3	0.9	2.1	100	2.1
1968	2.1	0.9	1.9	103	1.8
1969	5.5	0.9	5.0	107	4.7
1970	8.0	0.9	7.2	111	6.5
1971	9.8	0.9	8.8	116	7.6
1972	9.6	0.9	8.6	118	7.3
1973	18.0	0.75	13.5	122	11.1
1974	36.7	0.75	27.5	139	19.8
1975	37.3	0.9	33.6	161	20.9
1976	15.6	0.9	14.0	173 (est.)	8.1

Source: Table 2-A3 and ADL estimates as described.
Index from U.S. Bureau of Labor Statistics, Wholesale
Prices and Price Indexes, Machinery and Equipment.

As can be seen from this table, AMC's annual investments for machinery and equipment associated with automobile production have increased significantly over the period of investigation, both in real terms (adjusted amount) and in current terms.

Perhaps the most significant observation on this table is the sharp decline in investment in this account in 1976. There can be no doubt that AMC has deferred some capital spending; the future effects and potential problems this causes will be of significant interest to analysts.

c. Annual Investments in Special Tooling

American Motors' annual investments in special tooling are shaped by a number of unique characteristics. Primary among these is the stated policy of AMC to adhere to no regular or annual model change policy. Additionally, with the exception of the AM General special government vehicle business, AMC's tooling investments are solely oriented toward the automobile business. Thirdly, AMC is least able to afford capital spending for any purpose, especially the risk-prone tooling area.

The reported annual investments in special tooling for AMC for the years 1967-1976 are presented in Table 2-A8. These figures appear annually in the company's 10-K report.

TABLE 2-A8. ANNUAL TOOLING INVESTMENT, AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Reported Total</u>	<u>Index</u>	<u>Adjusted Total</u>
1967	35.5	100	35.5
1968	15.3	103	14.9
1969	38.0	107	35.5
1970	26.1	111	23.5
1971	13.5	116	11.6
1972	17.8	118	15.1
1973	43.5	122	35.7
1974	50.8	139	36.5
1975	44.7	161	27.8
1976	26.7	173 (est.)	15.4

Source: Company 10-K reports, index from Table 2-A7.

These reported tooling investments show a marked inconsistency. Some order can be derived from the figures, however, especially on an adjusted basis by examination of several pieces of additional information.

Referring to the adjusted column, the pattern for the four years 1967-1970 can be interpreted as AMC's attempt to simulate an annual model change by heavy expenditures in alternate years, with moderate spending in the intervening years. In 1970 AMC broke from this pattern and announced a corporate policy of avoiding annual model changes. Thus, the years 1971-1975 can be interpreted as a period of gradual increases in tooling costs starting from a relatively low base, if one factors the years 1973 and 1974 as representative of additional incremental tooling for the Pacer introduced in 1975. The final year, 1976, appears to be a return to the erratic alternation of the earlier period.

The project team attempted to document the preceding analysis by reference to specific models and model changes. This effort led to no results in which confidence could be placed, primarily as a result of inflated, distorted or imprecise reports of the "cost" of one particular car model or another.

The disaggregation performed on tooling investments followed the same logic as the machinery and equipment analysis, with an adjustment to the factors to reflect the project team's assumption that AMC's non-automobile businesses were less tooling-intensive than they were machinery-intensive. Thus, the factors derived for the machinery and equipment analysis were modified, and are shown with the resulting tooling investments in Table 2-A9.

TABLE 2-A9. ANNUAL TOOLING INVESTMENT ASSOCIATED WITH AUTOMOTIVE PRODUCTION, AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Reported Total</u>	<u>Derived Factor</u>	<u>Estimated Amount</u>
1967	35.5	.95	33.7
1968	15.3	.95	14.5
1969	38.0	.95	36.1
1970	26.1	.95	24.8
1971	13.5	.95	12.8
1972	17.8	.95	16.9
1973	43.5	.85	37.0
1974	50.8	.85	43.2
1975	44.7	.95	42.5
1976	26.7	.95	25.4

Source: Table 2-A8 and ADL estimates as described.

Despite the disaggregation estimates, the pattern of investment remains erratic, reflecting the continuing problems AMC faces in the marketplace.

The results of the preceding analysis of capital investment for fixed assets and special tools are summarized in Table 2-A10 which provides some insight into the manner in which AMC has allocated its capital resources.

TABLE 2-A10. DISAGGREGATED TOOLING AND CAPITAL INVESTMENTS--COMPARISON (\$ MILLIONS)

<u>Year</u>	<u>Investment</u>	<u>Capital Investment</u>	<u>TOTAL</u>	<u>Tooling %</u>	<u>Capital %</u>
1967	33.7	2.8	36.5	92%	8%
1968	14.5	2.7	17.2	84%	16%
1969	36.1	7.9	44.0	82%	18%
1970	24.8	13.0	37.8	66%	34%
1971	12.8	12.6	25.4	50%	50%
1972	16.9	12.5	29.4	57%	43%
1973	37.0	19.3	56.3	66%	34%
1974	43.2	33.3	76.5	56%	44%
1975	42.5	37.4	79.9	53%	47%
1976	25.4	21.7	47.1	54%	46%

Source: Table 2-A5, Table 2-A7, Table 2-A9.

One interesting speculation on this data is that AMC may be attempting to balance tooling and capital expenditures, as evidenced by the relatively stability of the tooling investment percentage at or near 50% since 1971 (excepting 1973 and the abnormality introduced by Pacer development). AMC's future results will add new evidence to support or refute this assertion.

d. Annual Operating Costs for Maintenance, Repairs and Rearrangements

American Motors has consistently referred to this cost item in their financial reports as "Maintenance and Repairs," and has not employed the term "Rearrangements." This can be taken as a direct result of the fact that AMC has effectively only two main plants--Kenosha for the automobiles and Toledo, Ohio for the Jeep models. Thus, rearrangements corresponding to model line shifts are not relevant.

Table 2-A11 presents the reported annual costs for maintenance and repairs for AMC from 1967-1976. These figures are taken from the "Notes to financial statements" in each year's 10-K report.

TABLE 2-A11. CONSOLIDATED MAINTENANCE AND REPAIRS EXPENSE,
AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Reported Amount</u>
1967	14.2
1968	15.0
1969	16.9
1970	20.5
1971	23.0
1972	29.3
1973	40.7
1974	43.8
1975	43.9
1976	44.3

Source: Company 10-K reports.

These amounts are remarkable for the stability of the trend, especially when compared with the annual capital expenditures analyzed in the preceding section. It would appear from these figures that the primary determinants of this account are sales, the size of the fixed asset base and inflation. Over the period this cost item has increased at an average 12% annually, and the growth rate has been consistently between 11.5% and 13%. This growth has been strikingly consistent with the growth in AMC's revenues since 1970, which has averaged 13.4% over this period. This relationship implies that for AMC there is a fixed relationship between sales revenue and maintenance expense. For the years in question, this relationship has averaged 2% of revenues each year. Table 2-A12 presents the relevant figures for 1970-1976.

TABLE 2-A12. MAINTENANCE AND REPAIRS RELATED TO REVENUES,
AMC 1970-1976 (\$ MILLIONS)

<u>Year</u>	<u>Maintenance and Repairs</u>	<u>Total Revenues</u>	<u>M&R Percentage</u>
1970	20.5	1,089.8	1.88%
1971	23.0	1,232.6	1.87%
1972	29.3	1,403.8	2.09%
1973	40.7	1,739.0	2.34%
1974	43.8	2,000.2	2.19%
1975	43.9	2,282.2	1.92%
1976	44.3	2,315.5	1.91%

Source: Company 10-K reports, Table 2-A11.

Based on this consistent relationship, the project team determined that a direct sales-related disaggregation would be appropriate for this expense item. Years prior to 1969 were not disaggregated as the existence of the appliance operations in those years makes reported results inconsistent with later results. Table 2-A13 presents sales-weighted disaggregated maintenance and repairs information.

TABLE 2-A13. MAINTENANCE AND REPAIRS-AUTOMOTIVE OPERATIONS,
AMC 1969-1976 (\$ MILLIONS)

<u>Year</u>	<u>Consolidated M&R</u>	<u>Automotive Sales %</u>	<u>Disaggregated M&R</u>
1969	16.9	76%	12.8
1970	20.5	77%	15.8
1971	23.0	79%	18.2
1972	29.3	83%	24.3
1973	40.7	90%	36.6
1974	43.8	90%	39.4
1975	43.9	83%	36.4
1976	44.0	80%	35.2

Source: Table 2-A6, Table 2-A11, Table 2-A12.

These amounts compare in magnitude with the annual investments in tooling and with capital investments. The future expenses of AMC in this area will provide insight into the validity of the relationship of M&R to sales.

e. Annual Operating Costs for Research and Development

Consolidated research and development (R&D) expenses are available from published financial reports of AMC for the years 1972-1976. Prior to 1972 AMC did not disclose these amounts. The figures presented in Table 2-A14 are taken from the company's annual 10-K reports.

TABLE 2-A14. CONSOLIDATED RESEARCH AND DEVELOPMENT EXPENSE, AMC 1972-1976 (\$ MILLIONS)

<u>Year</u>	<u>Consolidated R&D</u>
1972	30.0
1973	38.2
1974	38.1
1975	36.6
1976	38.1

Source: Company 10-K reports.

AMC does not publish any information on the composition or nature of R&D expenses. Thus, for disaggregation purposes, the project team necessarily relied on elementary revenue ratios, using an average 85% to represent the R&D investment each year allocated to automotive research. While the sales revenue ratio varies during the period, a stable ratio was thought to more accurately reflect the investment nature of R&D spending. The resulting disaggregated R&D is presented in Table 2-A15.

TABLE 2-A15. DISAGGREGATED R&D EXPENSE, AUTOMOTIVE OPERATIONS, AMC 1972-1976 (\$ MILLIONS)

<u>Year</u>	<u>Consolidated R&D</u>	<u>Derived Factor</u>	<u>Derived R&D</u>
1972	30.0	0.85	25.5
1973	38.2	0.85	32.5
1974	38.1	0.85	32.4
1975	36.6	0.85	31.1
1976	38.1	0.85	32.4

Source: Table 2-A14, ADL estimates as described.

The disaggregated R&D costs show a consistent level of R&D spending over the period. The following should be noted:

- 1) AMC's R&D expenses have averaged 1.9% of revenues over the period.
- 2) Efforts to discern the components or nature of AMC's R&D spending were frustrated by a total lack of published information.

f. Annual Operating Costs for Depreciation and Amortization

The depreciation and amortization policies of American Motors, as summarized in Part I of this report, are in line with industry practice. Land is not depreciated, land improvements are depreciated over 20 years, buildings over 40 years, machinery and equipment are depreciated over lives ranging from 12 to 25 years. Approximately 37% of the asset base is depreciated on a straight-line basis; the remainder on an accelerated basis. The details of the accelerated methods used are not disclosed.

Amortization of special tools is performed ratably over the estimated production of the models to which those tools relate, but the categorization of types of tooling and estimated production lives are not disclosed by the company. Table 2-A16 presents the reported consolidated depreciation and amortization for AMC 1967-1976, as disclosed in the annual 10-K report.

TABLE 2-A16. REPORTED CONSOLIDATED DEPRECIATION AND AMORTIZATION,
AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Depreciation of PP&E</u>	<u>Amortization of Special Tools</u>	<u>TOTAL</u>
1967	13.4	36.5	49.9
1968	11.0	28.6	39.6
1969	10.2	23.9	34.1
1970	12.7	30.6	43.3
1971	13.8	22.4	36.2
1972	14.2	23.3	37.5
1973	13.7	20.7	34.4
1974	15.8	23.8	39.6
1975	19.1	35.2	54.3
1976	22.9	39.8	62.7

Source: Company 10-K reports: Schedule VI and Notes to Financial Statements

Annual charges for depreciation of plant, property and equipment have increased relatively steadily over this period, while the charges for amortization of special tools have been more volatile.

The disaggregation of PP&E depreciation was based in part upon the logic developed in the analysis of capital expenditures for buildings and machinery, and in part on examination of trends as they related to major events at AMC. Specifically, it was determined that 1970 represented an appropriate base year, as by that time the depreciation charges associated with AMC's appliance businesses would have been eliminated. The relationship of total costs to depreciation in 1970 established a factor of 1.1% for the depreciation charges. It was assumed that these charges would relate to automotive and government vehicles only, and the relationship established was extrapolated back for 1967-1969. The second step in the disaggregation was then to eliminate the portions of depreciation charges associated with the non-automotive line of business. Despite the change in the nature of this

business alluded to previously, the shift from military vehicle sales to transit bus sales, it was assumed by the project team that a constant ratio could be supported. Thus, based on the components of revenue and the assumption that automobile production is traditionally more intensive of capital equipment, the factors presented in Table 2-A17 were established and the resulting estimates calculated.

TABLE 2-A17. ANNUAL DEPRECIATION EXPENSE RELATED TO AUTOMOBILE PRODUCTION, AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Consolidated Depreciation</u>	<u>Estimated Factor</u>	<u>Estimated Depreciation</u>
1967	9.3*	0.8	7.4
1968	8.3*	0.8	6.6
1969	10.2	0.8	8.2
1970	12.7	0.8	10.2
1971	13.8	0.85	11.7
1972	14.2	0.88	12.5
1973	13.7	0.9	12.3
1974	15.8	0.9	14.2
1975	19.1	0.88	16.8
1976	22.9	0.85	19.5

*Adjusted for appliance business.

Source: Table 2-A6, Table 2-A16, ADL estimates as described.

The single critical observation to be made on these data is that the cash flow from depreciation for the automotive business of AMC has not recently been sufficient to finance capital expenditures for property, plant and equipment. Table 2-A18 provides this comparison.

TABLE 2-A18. DEPRECIATION OF PP&E AND INVESTMENTS IN PP&E,
AUTOMOTIVE OPERATIONS ONLY, AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Estimated Capital Expenditures</u>	<u>Estimated Depreciation</u>	<u>Capital Required in Addition</u>
1967	2.8	7.4	(4.6 surplus)
1968	2.7	6.6	(3.9 surplus)
1969	7.9	8.2	(0.3 surplus)
1970	13.0	10.2	2.8
1971	12.6	11.7	0.9
1972	12.5	12.5	0
1973	19.3	12.3	7.0
1974	33.3	14.2	19.1
1975	37.4	16.8	20.6
1976	21.7	19.5	2.2

Source: Table 2-A10, Table 2-A17.

The annual costs of amortization of special tools were also disaggregated using logic developed in the previous investment analysis. Except for 1967 and 1968, which were normalized with 1969 and 1970 to eliminate the effects of the appliance business, the amortization factors were based directly on the investment factors, with a two-year lag to account for the fact that amortizations spreads investments over a model life. The resulting factors and estimates are presented in Table 2-A19.

TABLE 2-A19. ANNUAL AMORTIZATION EXPENSE RELATED TO AUTOMOTIVE OPERATIONS, AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Consolidated Amortization</u>	<u>Estimated Factor</u>	<u>Estimated Amortization</u>
1967	32.1*	.95	30.5
1968	26.2*	.95	24.9
1969	23.9	.95	22.7
1970	30.6	.95	29.1
1971	22.4	.95	21.3
1972	23.3	.95	22.1
1973	20.7	.95	19.7
1974	23.8	.95	22.6
1975	35.2	.85	29.9
1976	39.8	.85	33.8

*Adjusted for appliance business.

Source: Table 2-A9, Table 2-A16.

Table 2-A20 shows a comparison of estimated annual tooling investments with estimated annual tooling amortization, considering AMC's automotive operations only.

TABLE 2-A20. AMORTIZATION OF SPECIAL TOOLS AND INVESTMENTS IN SPECIAL TOOLS, AUTOMOTIVE OPERATIONS ONLY, AMC 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Estimated Tooling Investments</u>	<u>Estimated Amortization</u>	<u>Capital Deficit (surplus)</u>
1967	33.7	30.5	3.2
1968	14.5	24.9	(10.4)
1969	36.1	22.7	13.4
1970	24.8	29.1	(4.3)
1971	12.8	21.3	(8.5)
1972	16.9	22.1	(5.2)
1973	37.0	19.7	17.3
1974	43.2	22.6	20.6
1975	42.5	29.9	12.6
1976	25.4	33.8	(8.4)

Source: Table 2-A10, Table 2-A19.

g. Summary

Table 2-A21 presents a summary of the various items of investment and expense estimated by the project team to be related to AMC's automobile and light utility vehicle production.

TABLE 2-A21. SUMMARY: ITEMS OF INVESTMENT AND EXPENSE RELATED TO
AMC AUTOMOTIVE OPERATIONS, 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>PP&E</u>	<u>Tooling</u>	<u>MRR</u>	<u>R&D</u>	<u>Dep'n</u>	<u>Amort.</u>
1967	2.8	33.7	-	-	7.4	30.5
1968	2.7	14.5	-	-	6.6	24.9
1969	7.9	36.1	12.8	-	8.2	22.7
1970	13.0	24.8	15.8	-	10.2	29.1
1971	12.6	12.8	18.2	-	11.7	21.3
1972	12.5	16.9	24.3	25.5	12.5	22.1
1973	19.3	37.0	36.6	32.5	12.3	19.7
1974	33.3	43.2	39.4	32.4	14.2	22.6
1975	37.4	42.5	36.4	31.1	16.8	29.9
1976	21.7	25.4	35.2	32.4	19.5	33.8

2.3.2 CHRYSLER CORPORATION

a. Size and Scope

Chrysler Corporation is the third of the "big 3" automakers in the United States. With sales of \$9.7 billion, it is still some way behind Ford and GMC (see Table 2-C1).

The company describes its business in Form 10-K as:

"Chrysler Corporation and its domestic subsidiaries are engaged primarily in the manufacture, assembly and sale in the United States of Plymouth, Dodge and Chrysler passenger cars, Dodge trucks and related automotive parts and accessories. The three car lines offer conventional full-size and intermediate models and two of them also offer compact models. Chrysler imports the Dodge Colt and the Plymouth Arrow, which compete in the subcompact market with the domestically produced subcompacts offered by major United States competitors. Foreign subsidiaries of the Corporation manufacture passenger cars and trucks and related parts and accessories which are sold outside the United States. The Corporation and its domestic subsidiaries also manufacture powder metal products and chemical products, material amounts of which are sold outside the Corporation. Nonautomotive operations of Chrysler and its subsidiaries, substantially all of which are carried on in the United States and Canada, include the manufacture and sale of outboard motors, boats, inboard marine engines, industrial engines, and certain work under Government (primarily Department of Defense) contracts."

Table 2-C1 shows the worldwide scope of the company's activities and facilities. The company also owns nonmanufacturing subsidiaries engaged in leasing and real estate management.

The analysis of specific company data concentrates on the following items:

- 1) Investment in property, plant and equipment
- 2) Investment in special tooling
- 3) Operating cost for maintenance, repair and rearrangement
- 4) Operating cost for research and development
- 5) Operating cost for depreciation and amortization

TABLE 2-C1. WORLDWIDE SCOPE OF CHRYSLER OPERATIONS

A. United States

- Vehicle Assembly Plants:
 - Belvidere - Belvidere, IL
 - Hamtramck - Hamtramck, MI
 - Jefferson - Detroit, MI
 - Lynch Road - Detroit, MI
 - Missouri Truck - Fenton, MO
 - Newark - Newark, DE
 - New Stanton - New Stanton, PA
 - St. Louis - Fenton, MO
 - Warren Truck - Warren, MI
- Manufacturing Plants - Auto Components:
 - Amplex Harper - Detroit, MI
 - Amplex Van Wert - Van Wert, OH
 - Chrysler Plastic Products Corp. - Sandusky, OH
 - Brownstown Export - Brownstown Township, MI
 - Dayton Plant #1 - Dayton, OH
 - Clairpointe - Detroit, MI
 - Detroit Forge - Detroit, MI
 - Detroit Trim - Detroit, MI
 - Detroit Universal - Dearborn, MI
 - Eight Mile - Detroit, MI
 - Eldon Avenue - Detroit, MI
 - Fostoria - Fostoria, OH
 - Huber Avenue - Detroit, MI
 - Indianapolis Electrical - Indianapolis, IN
 - Indianapolis Foundry - Indianapolis, IN
 - Introl - Ann Arbor, MI
 - Introl - Scio, MI
 - Kokomo Casting - Kokomo, IN
 - Kokomo Transmission - Kokomo, IN
 - Lyons Trim - Lyons, MI
 - Mack Avenue Stamping - Detroit, MI
 - McGraw Glass - Detroit, MI
 - Michigan City Moulded - Michigan City, IN
 - Mound Road Engine - Detroit, MI
 - New Castle Forge - New Castle, IN
 - New Castle Machining - New Castle, IN
 - New Process Gear - Syracuse, NY
 - Outer Drive Stamping - Detroit, MI
 - Sterling Stamping - Sterling Township, MI
 - Toledo Machining - Perrysburg, OH
 - Trenton Chemical - Trenton, MI
 - Trenton Engine - Trenton, MI
 - Twinsburg Stamping - Twinsburg, OH
 - Vernor Tool and Die - Detroit, MI
 - Warren Stamping - Warren, MI

TABLE 2-C1. WORLDWIDE SCOPE OF CHRYSLER OPERATIONS (continued)

- Nonautomotive Plants:
 - Chrysler Boat - Plano, TX
 - Chrysler Outboard - Hartford, WI
 - Marine and Industrial Product - Marysville, MI
- Defense-Space Plants:
 - Chrysler Detroit Tank - Warren, MI
 - Chrysler Scranton Defense - Eynon, PA
 - Defense Engineering - Center Line, MI
 - Florida Space, Cape Canaveral, FL
 - Huntsville Electronic - Huntsville, AL
 - Space Division Michoud Plant - New Orleans, LA
 - Sterling Defense - Sterling Heights, MI
- Parts Depots:
 - Twenty-two located throughout the United States

B. Canada

- Vehicle Assembly Plants:
 - Pillette Road Truck - Windsor, Ont.
 - Tecumseh Road Truck - Windsor, Ont.
 - Windsor - Windsor, Ont.
- Manufacturing Plants:
 - Ajax Trim - Ajax, Ont.
 - Chrysler Canada Outboard - Barrie, Ont.
 - Etobicoke Casting - Toronto, Ont.
 - Perth Metal - Stratford, Ont.
 - Windsor Engine - Windsor, Ont.
 - Windsor Spring - Windsor, Ont.
- Parts Depots:
 - Six located throughout Canada

C. International

- Vehicle Assembly Plants:

Australia	Turkey
Brazil	Scotland
Colombia	Republic of South Africa
Spain	Ireland
Argentina	England
France	Mexico
Peru	Venezuela

TABLE 2-C1. WORLDWIDE SCOPE OF CHRYSLER OPERATION (continued)

● Manufacturing Plants:

Australia	Turkey
Brazil	Scotland
Spain	Republic of South Africa
Argentina	England
France	Mexico

● Parts Depots:

Australia	Peru
Belgium	Republic of South Africa
Columbia	England
Brazil	Ireland
Spain	Venezuela
Argentina	Mexico
France	

Chrysler traditionally reported capital investment for special tooling separately from property, rent and equipment for both the U.S. and international operations until 1971. As a result of the discontinuance of this practice from 1972 to 1976, it was necessary to find a way to disaggregate tools and dies from property, plant and equipment given only net book value for fixed assets "outside U.S. and Canada" and the consolidated data. The approach used by the project team for this disaggregation was to seek relationships in 1967-1971 financial data which could be applied to 1972 to 1976 information. The team discovered a useful relationship based on special tooling information and for that reason we discuss investment in special tooling first before property, plant and equipment.

b. Annual Investments in Special Tooling

Chrysler Corporation has reported annual consolidated capital expenditure for special tools over the past ten years (1967-1977) ranging from a low of \$136 million in 1971 to a high of \$298 million in 1973. The relative importance of special tooling expenditures is evidenced by the fact that a little more than 50% of the capital expenditures made by Chrysler Corporation were categorized as investment in special tooling. Table 2-C2 presents the Chrysler consolidated annual expenditures for special tools in both current and constant 1967 dollars. The following observations should be noted from Table 2-C2:

- 1) Inflation is a significant factor in the trend of capital expenditures for special tools over the ten-year time interval. Although the indices used were U.S., worldwide indices should not have a material effect.
- 2) Expenditures in real terms are declining. A linear regression calculation shows annual investments for special tools declining at the rate of \$9 million per year.
- 3) The deflated expenditures for the period 1973 to 1976 show a dramatic drop in a period when automotive manufacturers have been voicing concerns about excessive capital investments which they have been forced to make.
- 4) As will be evident from the subsequent sections, total Chrysler is a good approximation of Chrysler U.S. and Canada because of its high proportion to the total.

TABLE 2-C2. CHRYSLER CONSOLIDATED ANNUAL EXPENDITURES FOR SPECIAL TOOLS
IN ESTIMATED CONSTANT 1967 DOLLARS (DOLLARS IN MILLIONS)

<u>Year</u>	<u>Amount</u>	<u>Index</u> (1)	<u>Deflated Amount</u>
1967	\$201	100	\$201
1968	205	103	199
1969	272	107	254
1970	242	111	218
1971	136	116	117
1972	166	118	141
1973	298	122	244
1974	242	139	174
1975	220	161	137
1976	197	173 (est.)	114

Source: 10-K

(1) U.S. Bureau of Labor Statistics, Wholesale Prices and Price
Indexes, Machinery and Equipment.

Although the price index is only an approximation of the inflation impact on capital expenditures, it nevertheless raises some interesting issues which are in contradiction to popular perceptions. The slow growth or even decrease in deflated capital expenditure during the period 1973 to 1976 is accented by the final year when the figure is the lowest during the ten-year period in deflated dollars. This is particularly interesting since the business press has reported record spending for special tools and Chrysler has developed the Cordoba, Aspen/Volare series, Le Baron/Diplomat series, and new L-Body during this time period.

The project team required an approach to disaggregate U.S. and Canada expenditures in special tools from the Chrysler consolidated information given only detailed data for the period 1967-1971. The general approach used to disaggregate U.S. and Canadian capital expenditures was to seek past trends in 1967-1971 financial data and apply these relationships to current information. In all years from 1967-1976, total fixed assets (plant, property, and equipment as well as tools, dies, etc.) were listed for total Chrysler in detail and a single net asset figure for a category known as "Outside U.S. and Canada." Thus, the difference between the two is total fixed assets U.S. and Canada (see Table 2-C3).

Thus, the first disaggregation step required that data be categorized in the context of the United States and Canada. Then the exercise of capitalizing tools expenditures and amortizing these costs over time was simulated to approximate reality. The three variables needed to simulate the financial reporting mechanics are net book value (asset value minus depreciation or amortization), percentage amortized per year, and capital additions.

Using the published data of Chrysler Corporation from 1967-1971, it was discovered that domestic Chrysler had approximately 20% more of its net fixed assets in tools and dies than did the corporation as a

TABLE 2-C3. NET PROPERTY, PLANT AND EQUIPMENT (INCLUDING TOOLS, DIES, ETC.) (DOLLARS IN MILLIONS)

<u>Year</u>	<u>Total Chrysler</u>	<u>Total Chrysler Outside U.S. & Canada</u>	<u>U.S. & Canada (Including Large Trucks and Non-auto)</u>
1967	\$1407.5	\$459.9	\$ 947.6
1968	1472.0	477.3	994.7
1969	1753.0	534.3	1218.7
1970	1803.2	594.7	1208.5
1971	1728.6	618.7	1109.9
1972	1680.3	580.7	1099.6
1973	1926.2	590.3	1335.9
1974	2062.3	590.4	1471.9
1975	2114.9	605.8	1509.1
1976	2087.2	633.0	1454.2

Source: 10-K

whole (see Table 2-C4). Table 2-C5 estimates the percentage of tools to total plant for U.S. and Canada by applying a 20% premium to the actual percentage of the total corporation for 1972-1976.

TABLE 2-C4. RELATIONSHIP BETWEEN UNAMORTIZED TOOLS TO TOTAL NET PLANT - 1967-1971

<u>Year</u>	<u>% Tools to Total Plant - Total Chrysler (Actual)</u>	<u>% Tools to Total Plant - U.S. & Canada (Actual)</u>	<u>U.S. & Canada Premium (2÷1)</u>
1967	18.7%	22.2%	+19%
1968	18.9	23.4	+24
1969	21.6	26.1	+21
1970	24.8	30.1	+21
1971	23.3	28.6	+23

Source: 10-K

TABLE 2-C5. RELATIONSHIPS BETWEEN UNAMORTIZED TOOLS TO TOTAL NET PLANT - 1972-1976 (ESTIMATED)

	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>
% Tools to Total Plant - Total Chrysler (Actual)	22.3%	29.7%	28.3%	25.0%	26.9%
U.S. & Canada Factor (Estimated)	+20%	+20%	+20%	+20%	+20%
% Tools to Total Plant - U.S. & Canada (Estimated)	26.8%	35.6%	34.0%	30%	32.3%

Source: ADL Estimate

The case team estimated that nonautomotive and medium and heavy duty trucks accounted for approximately 5% of the total fixed assets of Chrysler Corporation. The 5% was arrived at based on the relative level of sales volume (using the annual report and Ward's Automotive) and limited asset information available. As a result, 5% of the total Chrysler consolidated assets were subtracted to achieve total World Chrysler automotive (<10,000 lb. GVW). Next, the relationships presented in Table 2-C5 were applied to total World Chrysler automotive (<10,000 GVW) to disaggregate net assets for U.S. and Canada automotive (<10,000 GVW) as listed in Table 2-C6. This was possible based on the assumption that U.S. and Canadian unamortized special tools were 20% higher than total average Chrysler.

TABLE 2-C6. CHRYSLER CORPORATION (U.S. AND CANADA) NET ASSETS IN PROPERTY, PLANT, AND EQUIPMENT (AUTOMOTIVE <10,000 GVW) (DOLLARS IN MILLIONS)

<u>Year</u>	<u>Unamortized Tools (est.)</u>	<u>Property, Plant and Equipment (est.)</u>	<u>Total PP&E (est.)</u>
1967	\$199.8	\$700.4	\$ 900.2
1968	221.1	723.9	945.0
1969	302.2	855.6	1157.8
1970	345.6	802.5	1148.1
1971	301.6	752.9	1054.5
1972	280.0	764.6	1044.6
1973	380.7	888.4	1269.1
1974	475.4	922.9	1398.3
1975	510.4	923.2	1433.6
1976	446.2	935.3	1381.5

Source: ADL Estimates

Further disaggregation of unamortized tools and dies to obtain yearly expenditures in tools and dies requires an implicit amortization rate. It was assumed that the amortization of tools as a percentage of unamortized tools for the tools of the total corporation in a given year would approximate the amortization rate. It was also assumed that the corporation used this amortization rate for the entire company. This assumption may be conservative from the standpoint of the U.S. and Canada since the rule is that domestically tools are written off at a higher rate than abroad.

The following are the yearly amortization rates approximated by ADL:

Total Chrysler Corporation Amortization Rates

1967	53%
1968	51%
1969	40%
1970	35%
1971	35%
1972	40%
1973	37%
1974	23%
1975	25%
1976	36%

Source: ADL Estimates

The general trend indicated by these amortization rates is downward, i.e., the higher rates tend to be in 1967-1968 and the lower rates in 1973-1976. This implies that Chrysler used to write its tooling expense off over a two-year period and is now taking from three to four years to amortize these expenditures. In light of the observations made by the project team about reduced expenditures on a constant dollar basis, the lower amortization rate points to a significant change

in financial strategy. Chrysler seems to be spending less on tooling expenditures and deferring its expense. This would have the effect of making its profit picture more favorable.

The only step remaining to determine special tooling expenditures is to simulate the mathematical equation below. The following relationship relates unamortized tools to capital expenditures:

$$\begin{bmatrix} \text{Unamortized} \\ \text{Tools U.S.} \\ \text{& Canada} \\ \text{Year N} \end{bmatrix} = \begin{bmatrix} \text{Amortiza-} \\ \text{tion Rate} \\ \text{Year N} \end{bmatrix} \times \begin{bmatrix} \text{Unamortized} \\ \text{Tools U.S.} \\ \text{& Canada} \\ \text{Year N-1} \end{bmatrix} + \begin{bmatrix} \text{Capital} \\ \text{Expen-} \\ \text{ditures} \\ \text{Year N} \end{bmatrix}$$

Using this relationship and solving for the unknown variable, the capital expenditures in each year are computed. The capital additions for tools, U.S. and Canada appear in Table 2-C7, as well as non-U.S. and Canada. Table 2-C8 shows relative production in these two sectors.

In an effort to corroborate the results just obtained, the project team analyzed a variety of data sources (see bibliography) to develop a detailed understanding of the company's spending as special tooling. This was accomplished by tracking the number of model changes which occurred over the ten-year period 1967-1976. Table 2-C9 describes these model changes (see GMC for classification).

The problem facing the project team was to identify costs for each of the changes. The team felt that each car manufacturer had different costs but no reliable source could be identified. As a result, it was assumed that Chrysler spent less than GMC for cosmetic, minor and major changes but had to spend as much as GMC for a totally new car. All of the manufacturers differ on the length of production run, degree of integration, degree of change, etc.

TABLE 2-C7. TOOLS, DIES, JIGS, PATTERNS AND FIXTURES (DOLLARS IN MILLIONS)

<u>Year</u>	<u>Unamortized Tools 12/31 (Estimated)</u>	<u>Average Amortization Rate (%)</u>	<u>Capital Additions (U.S. & Canada) (Estimated)</u>	<u>Capital Additions (Non-U.S. & Canada) (Estimated)</u>	<u>Capital Additions (Total) (Actual)</u>
1967	\$199.8	53%	\$147.9	\$52.7	\$200.6
1968	221.1	51	165.4	39.4	204.8
1969	302.2	40	213.5	56.7	270.2
1970	345.6	35	178.6	63.4	242.0
1971	301.6	35	93.3	42.6	135.9
1972	280.0	40	122.8	42.9	165.7
1973	380.7	37	248.3	49.3	297.6
1974	475.4	23	207.0	34.5	241.5
1975	510.4	25	173.9	46.0	219.9
1976	446.2	36	147.3	49.4	196.7

Source: ADL Estimates; 10-K

TABLE 2-C8. UNIT SALES OF CARS, TRUCKS AND TRACTORS BY AREA OF MANUFACTURE (UNITS IN THOUSANDS)

<u>Year</u>	<u>U.S. and Canada</u>	<u>Percent of Total</u>	<u>Outside U.S. and Canada</u>	<u>Total Chrysler</u>
1967	1723	77%	522	2245
1968	1973	76	637	2610
1969	1771	73	660	2431
1970	1714	70	721	2435
1971	1778	67	884	2662
1972	2013	66	1015	3028
1973	2230	66	1172	3402
1974	1782	64	981	2763
1975	1586	64	890	2476
1976	2134	68	996	3130

Source: Annual Report

TABLE 2-C9. CHRYSLER PRODUCT ACTIVITY

\$'s in Millions	1977	1976	1975	1974	1973	1972
Tools & Dies (E)		147.3				122.8
NEW MODELS-Cars	LeBaron/Diplomat	EXISTING DRIVE TRAINS →	Aspen/Volare MAJOR ALL NEW	Cordoba → EXISTING DRIVE TRAINS →		
L-Body Small Car	MAJOR ALL NEW →					
MAJOR CHANGES CARS						
				-Charger S.E. -Fury -Gran Fury -Coronet	-Satellite	
				-Chrysler -Dart S.E. -Monaco		
MINOR CHANGES						-Plymouth*
Very Minor Changes				-Valiant -Fury* -Cordoba -Aspen/Volare* -Chrysler -Charger S.E. -Monaco	-Valiant -Imperial -Charger/ Coronet -Barracuda*	-Monaco/Polaris -Imperial -Charger/ Coronet -Barracuda*
DODGE TRUCKS			Minor Changes To the Line	No Significant Changes	*New Ramcharger Trailduster	*New Four Wheel Drive Other Minor Changes
DISCONTINUANCES					-Valiant -Imperial -Dart -Charger	-Polaris

TABLE 2-C9. CHRYSLER PRODUCT ACTIVITY (continued)

\$'s in Millions	1971	1970	1969	1968	1967	1966
Tools & Dies (E)	93.3	178.6	213.5	165.4	147.9	
<u>NEW MODELS-Cars</u>		<u>Challenger</u>	<u>EXISTING</u>	<u>DRIVE TRAINS</u>	<u>FEATURES</u>	
<u>MAJOR CHANGES</u>		<u>Sport</u>	<u>Satellite</u>	<u>MANY EXISTING</u>	<u>FEATURES</u>	
<u>CARS</u>						
	-Plymouth (1/2 Line) -Chrysler -Imperial	-Valiant -Dart -Duster -Barracuda	-Fury -Polara -Monaco -Imperial -Dart Swinger -Chrysler	-Charger -Coronet -Belvedere	-Barracuda -Dart -Valiant -Belvedere-GTX	
<u>MINOR CHANGES</u>						
<u>*Very Minor Changes</u>						
	-Valiant -Charger/ Coronet -Challenger -Monaco*	-Chrysler -Charger -Coronet -Polara -Imperial* -Belvedere -Fury*	-Chrysler -Coronet -Dart* -Belvedere* -Belvedere -Fury*	-Chrysler -Dart* -Imperial -Polara -Barracuda* -Fury	-Chrysler -Charger* -Coronet -Polara/Monaco	
<u>DODGE TRUCKS</u>	*Major \$50MM Engineering Restyling Light Duty Trucks	MAJOR ENGINEERING CHANGES	Tradesmen Vans Revamped	Adventurer Gets New Styling	New D-800 C-850	
<u>DISCONTINUANCES</u>						

The following listing presents the costs associated with the classified changes and the number of years required to accomplish the change:

Tooling Costs

(\$ millions)

	<u>Cost</u>	<u>Years Req.</u>	<u>Percent Each Year</u>
Very Minor	\$ 3	2	30% - 70%
Minor	7	2	30% - 70%
Major	23	2	30% - 70%
New Model/Existing Drive Train	100	3	10% - 30% - 60%
New Model/Downsize	150	-	10% - 30% - 60%

Source: ADL Estimates

Table 2-C10 tabulates the costs based on the events listed in Table 2-C9. Note that the bottom of Table 2-C10 compares the results obtained from the disaggregation basis and those from the events analysis. Although the numbers are not identical, they do show a fairly close relationship and tend to substantiate the disaggregation.

TABLE 2-C10. ESTIMATION OF MAJOR TOOLING CAPITAL ADDITIONS BY
PROJECT (DOLLARS IN MILLIONS)

		ASSUME		
		\$100 - Exist Drive Trains		
		\$150 - Downsize		
NEW MODELS		1977	1976	1975
LeBaron/Diplomat		90	45	15
			Aspen/Volare	Cordoba
L-Body		90	45	75
				30
				10
				15
MAJOR CHANGES				
CARS			ASSUME	
FINISH			15	
START-UP			8	
MINOR CHANGES			ASSUME	
			Very Minor	
FINISH			5 2	
START-UP			2 1	
OPTIONS				
TRUCKS				
RETOOLING, MIS.C. MAINT.				
TOTAL "EVENT ANALYSIS"		142	171	213
ESTIMATED "DISAGGREGATION"		147	174	207
				176
				116
				123

TABLE 2-C10. ESTIMATION OF MAJOR TOOLING CAPITAL ADDITIONS BY
PROJECT (DOLLARS IN MILLIONS) (continued)

<u>NEW MODELS</u>	<u>1971</u>	<u>1970</u>	<u>1969</u>	<u>1968</u>	<u>1967</u>	<u>1966</u>
<u>Challenger 60</u>			30	10		
<u>Satellite</u>		60		30	10	
<u>MAJOR CHANGES</u>						
<u>CARS</u>						
FINISH	45		60		90	45
START-UP	8		24		32	48
<u>MINOR CHANGES</u>						
FINISH	20		29		14	24
START-UP	10		10		6	6
<u>OPTIONS</u>						
<u>TRUCKS</u>						
<u>RETOOLING, MISC. MAINT.</u>	10		10		10	10
<u>TOTAL "EVENT ANALYSIS"</u>	113		213		257	188
<u>ESTIMATED "DISAGGREGATION"</u>	93		179		214	165
						132
						148

Source: ADL Estimates

c. Annual Investments in Property, Plant and Equipment

Chrysler has reported annual consolidated expenditures for property, plant and equipment over the last ten years (1967-1976) ranging from a low of \$114 million in 1971 to a high of \$376 million in 1969. Table 2-C11 lists the total consolidated investments in property, plant and equipment for Chrysler worldwide operations including non-automotive and vehicles over 10,000 lbs. (GVW). Table 2-C12 presents the capital expenditures in estimated constant 1967 dollars. The following observations were made by the project team from the preceding tables:

- 1) Inflation is a significant factor in the apparent growth of capital expenditures. Indexes used are for the U.S. but reflect the worldwide trend of inflation in buildings and machinery and equipment.
- 2) Expenditures in real terms are declining. A linear regression calculation shows annual investments for buildings and equipment declining at a rate of \$5 million and \$3 million respectively.

The disaggregation of property, plant and equipment was carried out by the project team in a way similar to the technique used for special tooling. The core of the technique is to develop and compare estimations based on disaggregation and events analysis. Together they present an investment expenditure picture for Chrysler of property, plant and equipment supported substantially by each other.

The disaggregation of property, plant and equipment comes about as a result of the special tools disaggregation. U.S. and Canadian automotive (<10,000 lb. GVW) property, plant and equipment was disaggregated in the special tools section into net asset figures. Table 2-C6 shows the proportionate amount of net fixed assets which are attributable to property, plant and equipment based on the assumption that special tools make up 20% more than the corporation average of tools to total net fixed assets. It also assumes that non-automotive and heavy trucks (<10,000 lb. GVW) makes up 5% of the total consolidated Chrysler.

TABLE 2-C11. CONSOLIDATED INVESTMENT IN PROPERTY, PLANT AND EQUIPMENT
(\$ MILLIONS)

<u>Year</u>	<u>Land</u>	<u>Buildings</u>	<u>Machinery & Equipment</u>	<u>Furniture</u>	<u>Construction in Progress</u>	<u>Total</u>
1967	11	93	117	3	(32)	192
1968	13	48	109	5	41	216
1969	25	105	172	5	69	376
1970	5	70	124	4	(29)	174
1971	4	60	108	5	(63)	114
1972	2	25	78	3	61	169
1973	6	44	170	7	104	331
1974	2	49	157	5	13	226
1975	2	88	155	5	(86)	164
1976	5	56	150	7	10	228

Source: Company 10-K Report

TABLE 2-C12. CAPITAL EXPENDITURES IN ESTIMATED CONSTANT 1967 DOLLARS

Year	Buildings			Equipment		
	<u>Actual</u> (1)	<u>Index</u> (2)	<u>Deflated</u>	<u>Actual</u> (1)	<u>Index</u> (2)	<u>Deflated</u>
1967	93	100	93	117	100	117
1968	48	107	45	109	103	106
1969	105	115	91	172	107	161
1970	70	123	57	124	111	112
1971	60	134	45	108	116	93
1972	25	145	17	78	118	66
1973	44	154	29	170	122	139
1974	49	172	28	157	139	113
1975	88	189	47	155	161	96
1976	56	204 (est)	27	150	173 (est)	87

Sources: (1) Form 10-K
 (2) E.H. Breckh Building Cost Index
 (3) U.S. Bureau of Labor Statistics, Wholesale
 Prices and Price Indexes - Machinery and Equipment

To arrive at capital expenditures for property, plant and equipment, the project team used a similar equation to the one used in the special tools section. This relationship, however, requires an implicit depreciation rate much like the amortization rate used in the special tools section. As a result, capital additions are computed using an implicit depreciation rate on net property which is assumed to be the corporation average. This depreciation rate was approximated by taking depreciation as a percentage of net book value of property, plant and equipment. Depreciation rates follow:

TOTAL CHRYSLER DEPRECIATION RATES BY YEAR

1967	17.3%
1968	11.4
1969	9.8
1970	9.9
1971	10.4
1972	9.6
1973	10.3
1974	9.6
1975	4.7
1976	6.4

Although the rates seem to be declining, it would be incorrect to draw any conclusions at this time because unlike the amortization rate for special tools, this composite depreciation rates contains a mix of buildings, equipment, etc. which could have changed over time.

Using a very similar equation as the one used for tools and dies, the capital additions for property, plant, and equipment are computed and are shown in Table 2-C13.

$$\begin{bmatrix} \text{Net Book Value} \\ \text{Property, Plant \&} \\ \text{Equipment - U.S. \&} \\ \text{Canada Year} \\ N \\ \text{(Known)} \end{bmatrix} = \begin{bmatrix} \text{Depreciation} \\ \text{Rate} \\ \text{Year N} \\ \text{(Known)} \end{bmatrix} + \begin{bmatrix} \text{Net Book Value} \\ \text{Property, Plant \&} \\ \text{Equipment - U.S.} \\ \text{X \& Canada Year} \\ N-1 \\ \text{(Known)} \end{bmatrix} + \begin{bmatrix} \text{Capital} \\ \text{Expenditure} \\ \text{Year N} \\ \text{(Unknown)} \end{bmatrix}$$

TABLE 2-C13. PROPERTY, PLANT AND EQUIPMENT (LESS TOOLS & DIES, U.S. AND CANADA) (\$ MILLIONS)

<u>Year</u>	<u>Net Book Value 12/31</u>	<u>Average Depreciation Rate %</u>	<u>Capital Additions</u>
1967	\$199.8 (est.)	17.3%	\$ 91.7 (est.)
1968	221.1	11.4	122.4
1969	302.2	9.8	250.4
1970	345.6	9.9	64.5
1971	752.8	10.4	49.2
1972	764.7	9.6	123.7
1973	888.4	10.3	240.3
1974	122.9	9.6	154.3
1975	923.2	4.7	97.6
1976	935.3	6.4	128.8

Source: ADL Estimates

Unlike tools and dies, capital expenditures in property, plant, and equipment can be broken down further into individual accounts.

Table 2-C14 lists the estimated expenditures of property, plant and equipment by individual account for the U.S. and Canada automotive.

Table 2-C14 was constructed using the calculated capital expenditure amounts and applying the overall corporation's trends in each account from 1967-1976. Table 2-C15 lists non-U.S. and Canadian accounts as well as non-auto and large trucks.

Table 2-C16 corroborates the disaggregation calculation of capital expenditures by listing expenditure events for both U.S. and Canada and non-U.S. and Canada. Although expenditure amounts are not estimated for each event, this presentation serves to substantiate the former approach since these major events follow the general trend of the capital expenditures. In addition, a square foot analysis is included which indicates the increase in purchased manufacturing and assembling area.

d. Annual Operating Costs for Maintenance, Repairs and Rearrangements

Operating costs for maintenance, repairs and rearrangements are a significant costs for Chrysler Corporation and reflect the expenditures for the following items:

- 1) Rearrangement of Plants
- 2) Tooling Repairs
- 3) Normal Maintenance

The project team reflected over many possible ways to correlate the expenditures in maintenance and repairs. The logical item which we elected to use was net assets because both special tools and property, plant and equipment were contained in this figure. Table 2-C17 presents the expenditure in maintenance and repair as a percentage of total net assets. The average of these numbers is 5.18%, however, the most significant part of this analysis is that the percentage per year is increasing which means that more money must be spent each year to maintain the equipment. This finding by the project team is consistent

TABLE 2-C14. U.S. AND CANADA ESTIMATED EXPENDITURES BY ACCOUNT
(\$ MILLIONS)

<u>Year</u>	<u>Land</u>	<u>Furniture</u>	<u>Buildings</u>	<u>Machinery & Equipment</u>	<u>Durable Containers</u>	<u>Construction in Progress</u>	<u>Total</u>
1967	\$ 0.4	\$1.5	\$41.6	\$ 89.5	-	(41.3)	\$ 91.7
1968	9.3	2.7	22.6	55.1	-	32.7	122.4
1969	18.8	2.4	70.5	98.0	5.0	55.7	250.4
1970	0.2	2.1	32.1	56.5	2.0	(28.4)	64.5
1971	1.7	2.2	25.9	45.4	1.1	(27.1)	49.2
1972	1.3	2.3	18.6	55.7	1.0	44.8	123.7
1973	4.0	4.9	32.2	120.6	3.3	75.3	240.3
1974	1.4	3.4	33.2	104.6	2.5	9.2	154.3
1975	1.0	2.7	52.5	91.9	0.5	(51.0)	97.6
1976	2.7	3.8	31.5	83.1	2.0	5.7	128.8

Source: ADL Estimates

TABLE 2-C15. NON-U.S. AND CANADA ESTIMATED EXPENDITURES BY ACCOUNT
 (Also includes non-auto and large truck) (\$ MILLIONS)

<u>Year</u>	<u>Land</u>	<u>Buildings</u>	<u>Machinery & Equipment</u>	<u>Furniture</u>	<u>Construction In Progress</u>	<u>Total</u>
1967	\$10.2	\$51.3	\$27.3	\$1.1	\$ 9.7	\$ 99.6
1968	3.3	25.6	53.8	2.3	8.2	93.2
1969	6.1	34.9	69.0	2.2	13.5	125.7
1970	4.8	37.5	65.7	2.1	(0.8)	109.3
1971	2.2	34.1	61.0	3.0	(35.6)	64.7
1972	0.5	6.8	20.9	0.8	16.5	45.5
1973	1.5	12.1	46.5	1.8	28.4	90.3
1974	0.7	15.4	49.7	1.6	4.2	71.6
1975	0.7	35.5	62.6	1.9	(34.6)	66.1
1976	2.1	24.2	65.1	2.9	4.3	98.6

Source: ADL Estimates

TABLE 2-C16. PROPERTY, PLANT AND EQUIPMENT (Less Tools & Dies) (\$ MILLIONS)

		<u>1976</u>	<u>1975</u>	<u>1974</u>	<u>1973</u>	<u>1972</u>
EVENTS-U.S. & Canada	128.8	97.6	154.3	240.3	123.7	
NEW FACILITIES						
-Recreation						
-Vehicle						
Assembly Plant						
ADDITIONS						
-Huntsville						
Electronic Div.						
200,000 sq. ft.						
-\$50M Machinery						
Trenton, Michigan						
ACQUISITIONS						
INCREASES IN						
SQUARE FEET (000's)						
U.S. & Canada						
MANUFACTURING	--					
ASSEMBLY	--					
TOTAL						
EVENTS-Non U.S. & Canada	98.6	66.1	71.6	90.3	45.5	
-Increased						
Assembly Plant						
in Brazil						
INCREASES IN						
SQUARE FEET (000's)						
Non-U.S. & Canada						
MANUFACTURING	--					
ASSEMBLY	--					
TOTAL						

TABLE 2-C16. PROPERTY, PLANT AND EQUIPMENT (Less Tools & Dies) (\$ MILLIONS) (Continued)

		<u>1971</u>	<u>1970</u>	<u>1969</u>	<u>1968</u>	<u>1967</u>
EVENTS-U.S. & Canada		49.2	64.5	250.4	122.4	91.7
NEW FACILITIES	-Parts Depot Elk Grove 285,000 sq. ft.	-New Stanton Construction Stopped	-New Stanton Started During Beginning of Year	-Major Construction	-Parts and Distribution Facilities Increased	
ADDITIONS			-New Building Built for Product Planning and Styling -New Intron Division Plans for Facilities	-Warren Michigan Truck Assembly Plant Increased by 140,000 sq.ft.		
ACQUISITIONS			-Acquired Two Plants to Prod. Speedometers, Odometers, etc.	-Acquired Sheet Vinyl Manufacturer		
INCREASES IN SQUARE FEET (000's)				No Information Available		
EVENTS-Non U. S. & Canada	64.7	109.3	125.7	93.2	99.6	
	-Expand Operations in Adelaide Australia	-\$62 Plant in Brazil	-New Facilities in Australia, Africa, Europe and Latin America	-\$21 for Chrysler do Brazil -280,000 sq. ft. Manufacturing Facility Started in Chrysler do Brazil	-\$24 in Rootes Motors	

TABLE 2-C17. MAINTENANCE AND REPAIR TO TOTAL ASSETS (\$ MILLIONS)

<u>Year</u>	<u>Maintenance and Repair</u>	<u>Assets</u>	<u>Percent Maintenance and Repair to Assets</u>
1967	166	3980	4.2%
1968	225	4441	5.1
1969	227	4726	4.8
1970	216	4816	4.5
1971	247	5000	4.9
1972	307	5497	5.6
1973	403	6105	6.6
1974	338	6733	5.0
1975	302	6267	4.8
1976	449	7074	6.3

Source: 10-K

with our findings in special tools and property, plant and equipment that Chrysler seems to be spending less on new investment and hence must spend more to maintain what they have.

Table 2-C18 presents the estimated constant dollar value for maintenance and repair. From this presentation, the following is evident:

- 1) Constant 1967 dollar MRR expenditures are increasing in real terms. A linear regression calculation shows that MRR is growing at about \$9 million per year.
- 2) Coupled with the fact that investment in real terms of special tools and property, plant and equipment are declining the previous observation seems to indicate that Chrysler is using MRR in lieu of new investment.

Since the project team has found some conclusive evidence which correlates MRR with total net assets, the best way to disaggregate MRR was on the proportionate value of net assets.

Thus, Table 2-C19 relates the proportionate value of MRR allocatable to the U.S. and Canada automotive (<10,000 lb. GVW) as well as non-U.S. and Canada (includes non-automotive and heavy trucks).

e. Annual Operating Costs for Research and Development

Chrysler has reported operating costs for research and development during the ten-year period (1967-1976) as high as \$280 million in 1976 and as low as \$111 million in 1967. During this time period, Chrysler has announced many innovations and considered itself a leader in the field of automotive engineering. Table 2-C20 relates the estimated 1967 constant dollar analysis of operating costs in research and development. The following points should be considered when analyzing these figures:

- 1) Although the expenditures have more than doubled on a current dollar basis, the deflated amount shows a much more modest increase.
- 2) A linear regression analysis shows about a \$3 million dollar increase per year for R&D expense.

TABLE 2-C18. ESTIMATED CONSTANT 1967 DOLLAR ANALYSIS OF MAINTENANCE, REPAIRS AND REARRANGEMENTS (\$ MILLIONS)

<u>Year</u>	<u>MRR</u>	<u>Index</u>	<u>Deflated MRR</u>
1967	166	100	166
1968	225	106	212
1969	227	112	203
1970	216	119	182
1971	247	126	196
1972	307	134	229
1973	403	142	284
1974	338	159	213
1975	302	178	167
1976	449	200	225

Source: 10-K

TABLE 2-C19. DISAGGREGATION OF MAINTENANCE AND REPAIRS

<u>Year</u>	<u>Proportion of U.S. & Canadian Assets to Total</u>	<u>U.S. & Canada Maintenance & Repair</u>	<u>Proportion of Non-U.S. & Canadian Assets to Total</u>	<u>Non-U.S. & Canadian Maintenance & Repair</u>	<u>Total Maintenance & Repair</u>
1967	67%	111	33%	55	166
1968	68	153	32	72	225
1969	70	159	30	68	227
1970	67	145	33	71	216
1971	64	158	36	89	247
1972	65	200	35	107	307
1973	69	278	31	125	403
1974	71	240	29	98	338
1975	71	214	29	88	302
1976	70	314	30	135	449

Source: 10-K
ADL estimates

TABLE 2-C20. ESTIMATED OPERATING CONSTANT DOLLAR COSTS FOR RESEARCH AND DEVELOPMENT (\$ MILLIONS)

<u>Year</u>	<u>Reported Value</u>	<u>Index (1)</u>	<u>Deflated Value</u>
1967	\$111	100	\$111
1968	129	106	122
1969	162	112	145
1970	139	119	117
1971	146	126	116
1972	191	134	143
1973	247	142	174
1974	239	159	150
1975	199	178	112
1976	280	200	140

Source: 10-K

(1) See Maintenance, Repairs and Rearrangements Analysis

Chrysler has consistently spent between 1.7% to 2.3% of revenue per year on R & D expense as follows:

R & D as a Percent of Sales 1967 - 1976

<u>Year</u>	<u>Percent of Sales</u>
1967	1.8%
1968	1.8
1969	2.3
1970	2.0
1971	1.9
1972	2.0
1973	2.1
1974	2.2
1975	1.7
1976	1.8

Source: 10-K

The average over this ten-year period is 2% which suggests that this is the way in which Chrysler does its budgeting for this expense.

The project team felt that the only meaningful way to disaggregate Chrysler R & D for the U.S. and Canada was to investigate: 1) the proportionate amount of U.S. and Canadian sales to total and 2) proportionate square feet used by R & D for U.S. and Canada versus the total. The two methods produced the following results:

PROPORTIONATE VALUE OF U.S. AND CANADA TO TOTAL

<u>Year</u>	<u>Square Feet</u>	<u>Unit Sales</u>
1967	75%	77%
1968	73	76
1969	71	73
1970	68	70
1971	65	67
1972	69	66
1973	67	66
1974	70	64
1975	69	64
1976	69	68

Source: ADL Estimate

As a result, the case team felt that even though the two correlated very well, the square foot analysis would be the more accurate. This correlation, however, helps to substantiate the validity of the final numbers. Table 2-C21 relates the allocation of square feet and proportionate value of U.S. and Canada and non-U.S. and Canada results.

f. Annual Operating Costs for Depreciation and Amortization

The general depreciation policies for Chrysler are described in Part I of this report. In its Form 10-K, the company states that: "The Corporation and its consolidated subsidiaries, except the subsidiaries named below, generally follow the policy of accelerating depreciation in the early years of use by means of a declining balance method which results in accumulated depreciation of approximately two-thirds of the depreciable cost during the first half of the estimated lives of the property. The weighted average depreciation lives of assets

TABLE 2-C21 RESEARCH AND DEVELOPMENT EXPENSE

Square Feet - Research & Development (000's)

<u>Year</u>	<u>United States</u>	<u>Outside U.S.</u>	<u>Total</u>	<u>Percent in U.S.</u>
1967				75% (est)
1968				73 (est)
1969				71 (est)
1970				68 (est)
1971	1947	1053	3000	65
1972	2293	1051	3344	69
1973	2329	1133	3462	67
1974	2414	1053	3467	70
1975	2414	1100	3514	69
1976	2429	1089	3518	69

R & D Allocation - (Dollars in Millions)

<u>Year</u>	<u>U.S. & Canada</u>	<u>Outside U.S. & Canada</u>	<u>Total</u>
1967	83.3 (est)	27.7 (est)	111.0 (Actual)
1968	94.2	34.8	129.0
1969	115.0	47.0	162.0
1970	94.5	44.5	139.0
1971	94.9	51.1	146.0
1972	131.5	59.0	190.5
1973	165.5	81.5	247.0
1974	167.2	71.6	238.8
1975	137.3	61.7	199.0
1976	193.6	86.8	280.4

Source: ADL Estimates

are as follows:

Buildings (including improvements and building equipment)	33 years
Machinery and Equipment	13 years
Furniture	13 years

Costs of tools, dies, jigs, patterns and fixtures have been amortized on the basis of anticipated production of particular products, with such adjustments as may be necessary to amortize fully the cost of such items upon completion of production."

Reported consolidated depreciation and amortization for the ten-year period (1967-1976) are given in Table 2-C22. Both amortization and depreciation have been erratic over the time period pointing to economic conditions and financial policies. The average depreciation for the ten-year period is \$163 million with a standard deviation of \$18 million. The average amortization for the ten-year period is \$183 million with a standard deviation of \$32 million.

The project team estimated the U.S. and Canadian automotive (<10,000 lb. GVW) depreciation and amortization by using the weighted average yearly rates used in sections b. and c. These rates were used on ending year balances and capital additions estimated in sections b. and c. The results appear in Table 2-C23 and reflect numbers which are based on the analysis done in the previous sections.

g. Summary

Table 2-C24 summarizes the items of investment and expense which were estimated by the project team to be related to U.S. and Canadian automotive.

TABLE 2-C22. CONSOLIDATED DEPRECIATION AND AMORTIZATION (\$ MILLIONS)

<u>Year</u>	<u>Depreciation</u>	<u>Amortization</u>	<u>Total</u>
1967	\$152	\$161	\$313
1968	161	186	347
1969	168	167	335
1970	174	172	346
1971	174	183	357
1972	171	195	366
1973	178	193	371
1974	182	139	321
1975	124	171	295
1976	141	261	402

Source: 10-K

TABLE 2-C23. DEPRECIATION AND AMORTIZATION FOR U.S. AND CANADA AUTOMOTIVE
(\$ MILLIONS)

<u>Year</u>	<u>Depreciation</u>	<u>Amortization</u>
1967	135	141
1968	98	144
1969	119	132
1970	118	135
1971	99	137
1972	112	144
1973	117	148
1974	120	112
1975	97	137
1976	117	211

Source: ADL Estimates

TABLE 2-C24. SUMMARY: ITEMS OF INVESTMENT AND EXPENSE RELATED TO
U.S./CANADIAN AUTOMOTIVE (\$ MILLIONS)

<u>Year</u>	<u>Tooling</u>	<u>PP, & E</u>	<u>MRR</u>	<u>R & D</u>	<u>Depreciation</u>	<u>Amortization</u>
1967	\$148	\$ 92	\$111	\$ 83	\$135	\$141
1968	165	122	153	94	98	144
1969	214	250	159	115	119	132
1970	179	65	145	95	118	135
1971	93	49	158	95	99	137
1972	123	124	200	132	112	144
1973	248	240	278	166	117	148
1974	207	154	240	167	120	112
1975	174	98	214	137	97	137
1976	147	129	314	194	117	211
Average	170	132	197	128	113	144
Standard Deviation	46	67	64	38	12	26

Source: ADL Estimates

2.3.3 FORD MOTOR COMPANY

a. Size and Scope

With total corporate sales in 1976 of \$28.8 billion, and North American automotive sales of approximately \$18.6 billion (see Table 2-F1), Ford Motor Company continued in its position as the second-largest corporation participating in the domestic automobile business and as holder of the second-largest share of revenues derived by domestic manufacturers from North American automotive sales.

Beyond a full line of passenger automobiles and light-duty trucks, Ford's automotive business includes heavy, over-the-road trucks, buses, and wheeled off-road trucks and vehicles. In addition to these diverse products considered as Ford's automotive business, the company engages in aerospace and defense sales, contract research and consumer electronics (Latin America) through its consolidated subsidiary, Ford Aerospace. Additionally, Ford produces steel, glass and other basic materials, some portions of which are sold to external buyers. Another significant non-automotive business is Ford's tractor operations, producing principally wheeled farm tractors and related equipment. On a nonconsolidated basis (i.e., revenues, costs, assets and liabilities not included in Ford consolidated financial reports), Ford participates through Ford Credit, a wholly-owned subsidiary, in the retail, wholesale and institutional credit business, commercial, industrial and real estate financing, insurance, leasing and land development.

In summary, Ford Motor Company's businesses can be listed as follows:

- 1) Automotive products
 - Automobiles
 - Trucks
 - Buses
 - Spare parts
- 2) Tractors and related equipment

- 3) Space, defense and electronic products*
- 4) Basic materials
 - Steel
 - Glass
- 5) Financial services (not consolidated)
 - Insurance
 - Credit
 - Land development

To provide some scope for the subsequent analysis, it is useful to point out that the Automotive business--as broadly defined by Ford for the purposes of their published financial reports--accounted for 92% of sales and 85% of pretax income for the corporation in 1976. Within this business the revenues were derived 70% from the United States and Canada and 30% from outside this area. The following table, reproduced from the 1976 Form 10-K report of Ford, shows the composition and extent of automotive sales for the years 1972-1976.

TABLE 2-F1. AUTOMOTIVE SALES--FORD MOTOR COMPANY 1972-1976 (\$ MILLIONS)

	<u>1976</u>	<u>1975</u>	<u>1974</u>	<u>1973</u>	<u>1972</u>
Automotive Sales					
U.S. and Canada	\$18,555	\$14,765	\$15,750	\$15,785	\$13,980
Outside U.S. and Canada	<u>7,944</u>	<u>6,923</u>	<u>5,778</u>	<u>5,255</u>	<u>4,536</u>
Total Automotive	\$26,499	\$21,688	\$21,528	\$21,040	\$18,516
Percent Total Sales	92%	90%	91%	91%	92%

Source: Company 10-K, 1976

Several observations about Ford's automotive business can be made from this data. First, the automotive business has accounted for more

*Ford dismantled and sold its Philco appliance business in 1973-1975. The amounts involved were not material.

than 90% of corporate sales for each of these five years. Secondly, while the revenues derived from automotive operations outside of North America have grown steadily at an average rate of 15% annually over this period, North American automotive operations have moved erratically over this period, with an average annual increase of 7% composed of two years of substantial growth, one of level activity and one of significant decline. Finally, it should be noted that total automotive revenues increased over the period at an average rate of 9.4%, with substantial growth in the last year reported.

Physically, Ford's automotive operations are heavily concentrated in the United States and Canada, as one would expect given the revenue relationships detailed above. Ford's component and subassembly facilities in the United States include engine plants, casting plants, stamping plants, transmission plants, an axle plant, and glass, paint and trim plants. Final assembly of automobiles and light trucks in North America is conducted at 17 locations as noted in the following table.

TABLE 2-F2. FORD FINAL ASSEMBLY PLANTS

<u>Location</u>	<u>1977 Product Line</u>
Atlanta, GA	LTD II, Cougar XR-7, Ranchero
Chicago, IL	Thunderbird
Dearborn, MI	Mustang II
Kansas City, MO	Comet, Maverick, light trucks
Lorain, OH	Cougar, LTD II, light trucks
Louisville, KY	Light trucks
Los Angeles, CA	Thunderbird, LTD
Mahwah, NJ	Granada, Monarch, light trucks
Metuchen, NJ	Bobcat, Pinto
Norfolk, VA	Light trucks
St. Louis, MO	Mercury
San Jose, CA	Pinto, Mustang II, light trucks
Twin Cities, MN	LTD, light trucks
Wayne, MI	Granada, Monarch, Bronco, light trucks
Wixom, MI	Lincoln Continental, Mark IV
Oakville, Ontario	Ford, Mercury, Meteor, light trucks
St. Thomas, Ontario	Pinto, Maverick

Source: Ward's Automotive Reports, Company annual reports

The project team was unable to develop information on the size (square footage) or investment in these locations; in contrast with other automotive manufacturers, Ford is reluctant to disclose these data beyond the summary level required by law.

b. Annual Investments in Property, Plant and Equipment

Table 2-F3 below presents the reported annual capital expenditures of Ford and its consolidated subsidiaries for the years 1967-1976. The "total" column is from the 10-year Financial Summary which appears in Ford's 1976 annual report as "Capital expenditures for expansion, modernization and replacement of facilities (excluding special tools)." The columns representing individual accounts are taken from the 10-K report for each year, Schedule V - Property, Plant and Equipment. Column C - Additions at Cost (Land, Land Improvements, and Leasehold Improvements) have been added together.

TABLE 2-F3. PUBLISHED CONSOLIDATED CAPITAL EXPENDITURES--
FORD 1967-1976 (\$ MILLIONS)

Year	Land and Improvements	Buildings	Machinery and Equipment	Office Furniture	Minerals, Timber	Construction in Progress	TOTAL
1967	37.2	143.7	449.6	9.2	-	21.4	661.1
1968	33.1	119.8	314.6	9.0	-	(14.1)	462.4
1969	36.5	116.0	421.7	11.1	-	(51.8)	533.5
1970	35.7	116.1	385.5	9.0	-	17.3	563.6
1971	30.2	88.9	437.2	8.8	-	43.7	608.8
1972	30.6	99.9	476.2	11.6	-	72.6	690.9
1973	42.7	126.3	562.1	21.0	-	139.6	891.7
1974	41.0	134.9	696.4	12.7	3.8	(56.3)	832.5
1975	23.0	142.7	501.5	11.6	1.2	(65.8)	614.2
1976	18.9	79.8	501.7	9.8	0.3	(59.5)	551.0

Source: Company financial reports

The following observations should be made concerning Table 2-F3:

- 1) Machinery and equipment accounts for the dominant fraction of annual capital expenditures, averaging more than 70% of the total. The range of this portion extends from a low of 63% in 1973 to a high of 91% in 1976. (However, examination of the construction in progress figures, which affect primarily the buildings and machinery and equipment accounts, will reveal that these extremes were created somewhat artificially as a result of the effect of construction in progress on the total.) On a current basis (i.e., ignoring construction in progress) establishment of a 70% rule-of-thumb appears to be supportable.
- 2) Of all the tangible accounts within the capital expenditures group, machinery and equipment generally has the shortest depreciation life (generally less than 12 years). Thus, in spite of the \$4.7 billion gross additions shown for these years in total, the increase in net machinery and equipment undepreciated was approximately \$1 billion. (Determined by subtracting opening 1967 net amount from closing 1976 net amount.) While the capital requirements appear to be huge, the flow of capital through this account is rapid and, since basically unrelated to sales, predictable.
- 3) Land and improvements, office furniture, and minerals and timber are not individually or in the aggregate significant enough to warrant further analysis. In essence, these accounts comprise sums which are equivalent to or less than the resolution accuracy of subsequent analysis.
- 4) Construction in progress, insofar as it is not explained in detail as balances are allocated out to fixed accounts, should be ignored and a new total developed as a base for further disaggregation.

The table presented on the following page is derived from the previous table given the criteria detailed above.

TABLE 2-F4. SUMMARIZED CONSOLIDATED CAPITAL ADDITIONS* IN MATERIAL ACCOUNTS-FORD 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Buildings</u>	<u>Machinery and Equipment</u>	<u>TOTAL*</u>
1967	143.7	449.6	593.3
1968	119.8	314.6	434.4
1969	116.0	421.7	537.7
1970	116.1	385.5	501.6
1971	88.9	437.2	526.1
1972	99.9	476.2	576.1
1973	126.3	562.1	688.4
1974	134.9	696.4	831.3
1975	142.7	501.5	644.2
1976	79.8	501.7	581.5

*Net of construction in progress

Source: Table 2-F3

Perhaps the most striking feature of this data is the bulge in capital additions for 1973-1975. This period corresponds to Ford's development and execution of the corporation's largest single construction project since the Rouge Complex was erected prior to World War II--a 3.9 million square foot stamping, engine and assembly facility at Valencia, Spain. To the extent that Ford has revealed information on the extent of capital additions in North America and elsewhere, a significant portion of this bulge can be explained.

The most direct means of disaggregating capital additions between North American and international operations is by reliance on company--published approximate relationships. In responding to the requirements of Item 3* of Form 10-K, "Properties", companies were required to reveal the approximate fraction of aggregated 5-years past capital expenditures made by foreign subsidiaries. For Ford Motor Company the published fraction was consistently "approximately one-third" from 1970-1974, covering the period 1966-1974. Since this one-third included Canadian investment, to approximate North American investment the project analysts decided to multiply the 66% U.S. fraction by 1.1 to develop a North American fraction. This judgment was based on relationship of unit sales (Ford of Canada has consistently been near 10% of U.S. total--see 1976 annual report: "10-Year Summary of Vehicle Factory Sales") (pg. 40)), realization that Ford's businesses are more nearly identical between these two countries than any other, and lack of alternative information of greater reliability (except for 1975 and 1976, for which years accurate figures were published by Ford in Note 2 to the Financial Statements provided in the 1976 10-K). Thus, North American fractions of capital additions for 1967 to 1973 were assumed to be a constant 73%. The 1974 fraction was assumed to drop to 63%, based on relating the earlier constant rate to the last two years' published rate and the 1976 published 5-year average (again multiplied by 1.1) of 62% North American additions. These coefficients,

* Since 1970.

and the resulting North American capital additions derived, are presented in Table 2-F5. There was no basis for supposing that the fractions differed for machinery as opposed to buildings: that is, the assumption was made that the relationship of building investment to machinery and equipment investment is equivalent for the North American area and other areas.

Several important observations derive from the data presented in Table 2-F5. First, aside from the two major assumptions described above, the assumed relationship between unit sales and capital investment in the U.S. and Canada and the assumed relationship between building investment and machinery and equipment investment, the figures presented in this table derive from company published ratios and information. Secondly, the presence of decimal points should not imply an accuracy in the numbers to that extent, as the accuracy is at best limited by the derived factor. Additionally, the following observations should be noted:

- 1) Of the years under review, only 1973, 1974 and 1975 company reports provide any insight into the amount of facilities additions in North America. These figures, which are found in the operations review of each year's annual report, are as follows:

(millions of square feet)

<u>Year</u>	<u>World-wide Additions*</u>	<u>North American Additions</u>
1973	4.7	2.2
1974	6	"more than" 2.0
1975	3.9	2.6
1976	2.6	not disclosed

*Worldwide includes North America

- 2) Attempts to analyze the additions by type of facility to further explain the composition of annual additions proved ineffective, owing to the lack of comprehensive published information.

TABLE 2-F5. NORTH AMERICAN CAPITAL ADDITIONS, FORD 1967-1976
(\$ MILLIONS)

<u>Year</u>	<u>Derived Factor</u>	<u>Buildings</u>	<u>Machinery and Equipment</u>	<u>TOTAL</u>
1967	0.73	104.9	328.2	433.1
1968	0.73	87.5	229.7	317.2
1969	0.73	84.7	307.8	392.5
1970	0.73	84.8	281.4	366.2
1971	0.73	64.9	319.2	384.1
1972	0.73	72.9	347.6	420.5
1973	0.73	92.2	410.3	502.5
1974	0.63	85.0	438.7	523.7
1975	0.35*	49.9	175.5	225.4
1976	0.64*	51.1	321.1	372.2

[*Published in 10-K for 1976]

Source: Preceding table and ADL estimates as described

- 3) The derived factor of 63% for 1974 compares well with Henry Ford II's reported estimate of 65% (New York Times, July 31, 1974, pg. 1). His estimate, however, includes tooling additions and excludes Canadian additions.
- 4) Excluding 1975 as a clearly abnormal year in which capital spending had to be curtailed to maintain profitability, the mean annual spending has been \$412.4 million, with a standard deviation of only \$66 million. (For a discussion of the effects of inflation on these figures, see the approach developed in the General Motors analysis.)

* * *

The next step in the disaggregation of Ford's capital investments entailed attempting to reduce the amounts derived for North American capital additions to eliminate those portions not related to automobile and light truck production. Referring to the discussion of businesses in Section 3a above, this required adjustments for:

- 1) Trucks of GVWR over 10,000 pounds (and buses).
- 2) Tractors
- 3) Space, defense and related products

It was decided not to adjust for Ford's basic materials businesses (steel and glass) since these facilities exist primarily in support of automobile production and are products of a strategy which Ford developed to compete in the automobile industry.

In developing estimates of factors, the following facts and assumptions were used:

- 1) On a dollar sales basis, Ford's nonautomotive businesses have consistently supplied about 9% of revenues over the period of interest.
- 2) The nonautomotive businesses include aerospace and defense sales of \$250 to \$500 million annually (1972-1976, as reported in 1976 annual report); this business is typically less capital intensive than automotive manufacturing.
- 3) Unit sales of tractors have consistently been approximately 10% of unit sales of cars and trucks for North America over the period.

- 4) Ford's 1976 annual report notes that light trucks have accounted for 90% of unit truck sales in the industry in recent years.
- 5) It can be assumed that production of tractors and heavy trucks requires less incremental annual capital investment to support.
 - There is greater standardization of components and subassemblies
 - The manufacturing process is less automated
 - Test and acceptance requirements are less stringent

Given these elements, the project team developed assumptions as to automotive and light truck capital investment factors, using the reasoning described below, and focusing on investments in machinery and equipment. While on a revenue basis the fraction would simply be 91%, the assumption that the two major nonautomotive businesses--tractors and aerospace--are less capital intensive requires an adjustment upward, to an estimated 94%. This 94% thus represents automotive including all trucks and buses. On a unit basis heavy trucks and buses appear to account for about 5% of the automotive output; adjusting for their higher average prices and assumed lower capital intensity these products could account for 10% of the total automotive investment increments. Thus, the average total factor would be approximately 85% for automobiles and light trucks. This average was felt to be appropriate for machinery and equipment, but felt to underestimate the building investment (primarily because of the more extensive parts depot requirements for automotive service support). Thus, the assumptions adopted were 85% for machinery and equipment and 90% for buildings. The average of 85% for machinery was adjusted for one year--1969--to a lower figure of 80% to attempt to account for the installation in that year of a major medium and heavy truck facility at Louisville, KY. The resulting annual investment estimates are presented in Table 2-F6.

TABLE 2-F6. ESTIMATED ANNUAL CAPITAL EXPENDITURES FOR BUILDINGS, MACHINERY AND EQUIPMENT, FORD 1967-1976 NORTH AMERICAN AUTOMOBILE AND LIGHT TRUCK (\$ MILLIONS)

Year	Derived Disaggregation Factors		Annual Capital Expenditures		
	Buildings	Machinery and Equipment	Buildings	Machinery and Equipment	TOTAL
1967	0.9	0.85	94.4	279.0	373.4
1968	0.9	0.85	78.8	195.2	274.0
1969	0.9	0.80	76.2	246.2	322.4
1970	0.9	0.85	76.2	239.2	315.4
1971	0.9	0.85	58.4	271.3	329.7
1972	0.9	0.85	65.6	295.5	361.1
1973	0.9	0.85	83.0	348.8	431.8
1974	0.9	0.85	76.5	372.9	449.4
1975	0.9	0.85	44.9	149.2	194.1
1976	0.9	0.85	46.0	272.9	318.9

Source: Preceding table and ADL estimates as described

Comparison of this information with the preceding intermediate tables would not be especially revealing as they are directly related mathematically. However, comparison with Ford's reported total capital expenditures (excluding tooling) as presented in Table 2-F3 will show that total North American automobile and light truck capital investment ranged from a low of 31.6% of the reported corporate total in 1976 to a high of 60.4% of that total in 1969. The figures for all years are shown on the following page.

TABLE 2-F7. RELATIONSHIP OF DERIVED INVESTMENTS TO REPORTED CORPORATE TOTAL (\$ MILLIONS)

<u>Year</u>	<u>Derived Total</u>	<u>Reported Total</u>	<u>Derived Total %</u>
1967	373.4	661.1	56.5
1968	274.0	462.4	59.3
1969	322.4	533.5	60.4
1970	315.4	563.6	56.0
1971	329.7	608.8	54.2
1972	361.1	690.9	52.3
1973	431.8	891.7	48.4
1974	449.4	832.5	54.0
1975	194.1	614.2	31.6
1976	318.9	551.1	57.9

Source: Table 2-F3
Table 2-F6

Rather than focus on 1975, when the fraction was lowered by a combination of enforced austerity in the U.S. and the completion of the major capital project in Spain, the more important insight to be derived from these figures comes from a comparison of the first 5-year period, 1967-1971, with the later period 1972-1976. The average factor over the earlier period was 57.3%, with a fairly consistent spread about that mean. For the later period the average factor was 48.8%, and only in the latest year, 1976, was the factor higher than the average of the first period. These relationships appear to underscore the increasing emphasis within Ford upon investment for growth in international markets, in addition to (but not in place of) continued investment to maintain market position in North America.

Several additional observations should be made concerning these total figures:

- 1) In terms of annual percentage swings, there is generally more volatility in the buildings account than in the machinery and equipment account.
- 2) These figures cannot be directly related to published reports of regulation-related spending as the company exercises considerable discretion and arbitrary allocation of costs and expenses in compiling the published figures.
- 3) Aside from the most extensive projects or dramatic events (e.g., the Kentucky Truck plant in 1968-1969, the plant in Spain in 1973-1975, and the austerity cutbacks of 1975) the annual flow of capital investment is large enough to obscure most company actions and decisions from direct view.

c. Annual Investments in Special Tooling

Table 2-F8 presents the annual expenditures for special tooling for Ford's consolidated operations for the years 1967-1976. These figures are readily available in Ford's published reports; they appear in the 10-year financial summary (pg. 41 of the 1976 annual report) as "Expenditures for Special Tools." The table also presents the annual expenditures as adjusted by a price-level index to attempt to determine real spending levels in this area. While it is somewhat inaccurate to apply a domestic inflation index to expenditures which are partially made in other economies, nonetheless the information developed can have general applicability.

The adjusted expenditures for tooling revealed several significant relationships:

- 1) The mean adjusted expenditure annually was almost precisely \$400 million, with a standard deviation of \$55 million. (Ignoring the abnormal year 1975.)
- 2) A trend line calculation revealed that expenditures as adjusted were declining at about \$3 million annually. This number in itself is irrelevant--the index estimation accuracy cannot support a finding at this level of detail. However, if anything this figure provides support for the assertion that

TABLE 2-F8. CONSOLIDATED ANNUAL EXPENDITURES FOR SPECIAL TOOLING
(\$ MILLIONS)

<u>Year</u>	<u>Expenditure</u>	<u>Index (1)</u>	<u>Adjusted Expenditure</u>
1967	374.8	100	374.8
1968	416.9	103	404.8
1969	424.3	107	396.5
1970	483.5	111	435.6
1971	430.4	116	371.0
1972	462.8	118	392.2
1973	594.3	122	487.1
1974	618.7	139	445.1
1975	342.2	161	212.5
1976	503.7	173 (est.)	291.2

Source: Annual Report 1976; (1) U.S. Bureau of Labor Statistics, Wholesale Prices and Price Indexes, Machinery and Equipment.

Ford's annual tooling budget is essentially flat in real terms. Whether this actually imposes a ceiling on tooling expenditures each year or not, cannot be determined owing to the discretion the corporation has in the areas of amortization and capitalization of tooling costs.

The relationship of tooling expenditures in North America to consolidated tooling expenditures worldwide is not apparent from the published reports of the company. Over the course of this study the project team attempted various means of making this disaggregation, as reported in the individual company analyses. For Ford, the approach in which the analysts had the greatest degree of confidence relied on examination of overseas automotive sales as they related to North American automotive sales, and then adjusting those relationships in accordance with findings and assumptions as to tooling intensity. An attempt at aggregation analysis of Ford's tooling costs, such as that presented in the General Motors analysis, did not develop any information in which greater confidence could be placed.

Thus, the first step in geographical disaggregation of annual tooling costs was the establishment of relationships between automotive (company-defined) sales in North American and worldwide. The results of this analysis are presented in Table 2-F9. The unit sales relationships are taken from the 1976 annual report: "10-Year Summary of Vehicle Factory Sales." The dollar sales relationships are developed from the 1976 10-K report (for 1972-1976) and the 1971 10-K report (for 1967-1971).

The most important observations to be made on this data are the relatively stable percentages of overseas sales on both bases, and the consistently higher percentage year-by-year on the dollar basis.

- 1) While operating income has varied widely for the North American and overseas segments (see 1976 10-K, Item 1) the North American unit sales percentages have held basically constant. These figures could imply that Ford's overseas investments for growth are still being paced by the growth of the domestic market. (Or, alternatively, that Ford seeks to

TABLE 2-F9. DOLLAR AND UNIT SALES RELATIONSHIPS-NORTH AMERICAN AUTOMOTIVE AND WORLDWIDE, FORD 1967-1976

Year	Units (000)			Dollars (\$ millions) (1)		
	Total	North America	%	Total	North America	%
1967	3,504	2,434	69%	9,149	6,770	74%
1968	4,653	3,448	74%	12,527	9,896	79%
1969	4,849	3,363	69%	13,280	10,093	76%
1970	4,770	3,214	67%	13,481	9,976	74%
1971	4,933	3,351	68%	14,954	11,215	75%
1972	5,593	3,848	69%	18,516	13,980	76%
1973	5,871	4,102	70%	21,040	15,785	75%
1974	5,259	3,730	71%	21,528	15,750	73%
1975	4,578	3,033	66%	21,688	14,765	68%
1976	5,304	3,556	67%	26,499	18,555	70%

(1) 1971-1976 as published, automotive revenues only; 1967-1970 derived from published overseas percentage of total revenues.

Source: as described above

make overseas investments which will produce products which can be marketed internationally, such as Capri and Fiesta.)

- 2) North American dollar revenue percentages are consistently higher than unit percentages.

The direct conclusion of this observation is that the products sold in North America contribute a higher revenue per unit. By extension, these products can support a greater styling, design and tooling expense on an annual basis.

Having these sales relationships, and an assumption that North American automotive products are more tooling intensive, one would reasonably expect the North American percentage of tooling to be in the range of 80%-85% of consolidated totals. While this is higher than sales ratios, as described on the previously, it is also significantly higher than capital spending ratios as developed in the previous section. This relationship can be explained in part by the fact that overseas production investments tend to be for more basic models with projected longer model runs without major changes. For example the German built Capri has not had a complete skin redesign since its introduction in Europe in 1969. Thus, the project team determined that, with the exception of two years--1973 and 1974--when a major investment was being undertaken in a new product and facility overseas (i.e., Spain) the steady-state ratio of 80% would be used for geographical disaggregation. For the two abnormal years this ratio was adjusted downward to 70% (the 10% decrement, applied to the figures for the appropriate years, implies a tooling cost for Fiesta/Spain of \$120 million--compare with GM Table 2-G14).

The resulting geographically-disaggregated tooling expenditures are presented in Table 2-F10.

TABLE 2-F10. ANNUAL INVESTMENT FOR TOOLING IN U.S. AND CANADA, FORD
1967-1976 (\$ MILLIONS)

Year	Consolidated Total	Disaggregation Factor	U.S. and Canada	Adjusted* U.S. and Canada
1967	374.8	. 0.8	300.0	300.0
1968	416.9	0.8	333.6	323.9
1969	424.3	0.8	339.4	317.2
1970	483.5	0.8	386.8	348.5
1971	430.4	0.8	344.3	296.8
1972	462.8	0.8	370.2	313.7
1973	594.3	0.7	416.0	341.0
1974	618.7	0.7	433.1	311.6
1975	342.2	0.8	273.8	170.1
1976	503.7	0.8	403.0	232.9

*Indexed as in Table 2-F8

Source: Table 2-F8
ADL estimates as described

These figures are striking, especially on the indexed basis, for their consistency over the eight years 1967-1974, over which the mean was \$319 million and the standard deviation only \$18 million. Also notable is the sharp cutback in tooling expense for 1975, a bad year for the industry and for Ford. The pattern of spending shown indicates a basic strategic hesitation in 1975, and, in fact, during 1975 there were essentially no changes in Ford's products beyond the most minor trim changes which were amortized over the one year. Between December 31, 1974 and December 31, 1975, the unamortized special tools account on Ford's consolidated balance sheet declined by \$90 million. This was the only year over the period 1967-1976 in which special tooling amortization exceeded additions.

Of particular interest to the analyst will be the expenditures for special tooling in 1977 and 1978, to determine whether Ford has returned to the previous level or established a new level.

The last step in the disaggregation analysis involved elimination of tooling investments not associated with automobiles and light trucks. Based on an examination of Ford's businesses, the project team decided that nonautomotive businesses within Ford do not account for any significant tooling expenses. The only area of uncertainty as to this assumption is the tractor business; the analysts believe:

- 1) Model changes in tractors are evolutionary and incremental tooling investments are not required once the business is established.
- 2) In any case tractor production is immaterial when compared with automobile and light truck production.

Thus, the problem was reduced to one of eliminating tooling for medium and heavy trucks (including buses). Referring to the unit sales analysis of Section b of this company analysis, medium and heavy trucks account for approximately 5% of the unit sales of North American automotive within Ford. It is felt that their tooling intensity is such that at a maximum these products would account for 5% of incremental tooling expenditures. Therefore, the factor of 95% for automobiles and light trucks was established. The resulting disaggregated figures are given in Table 2-F11.

TABLE 2-F11. TOOLING INVESTMENT: NORTH AMERICAN AUTOMOBILE AND LIGHT TRUCK, FORD 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>North American Total</u>	<u>Assumed Factor</u>	<u>North American Auto/Lt. Truck</u>
1967	300.0	0.95	285
1968	333.6	0.95	317
1969	339.4	0.95	322
1970	386.8	0.95	367
1971	344.3	0.95	327
1972	370.2	0.95	352
1973	416.0	0.95	395
1974	433.1	0.95	411
1975	273.8	1.0*	274
1976	403.0	0.95	383

* Tooling expenditures for medium- and heavy-truck were assumed to be suspended in 1975.

Source: Table 2-F10
ADL estimates as described

Since these estimates are directly computed from the preceding set of estimates, the observations on this table are essentially equivalent to the previous remarks. In addition, however, one should note the relationship of disaggregated tooling expense to disaggregated capital expenditures (as presented in Table 2-F6). These relationships are shown in Table 2-F12.

d. Annual Operating Costs for Maintenance, Repairs and Rearrangements

As discussed in Part I of this report, maintenance, repairs and rearrangement expenses are a particular cost area which affords the automobile manufacturer with discretion and flexibility as to capital spending. In the case of Ford, MRR costs have consistently been substantial in relation to after-tax earnings, as well as in relation to capital expenditures. Table 2-F13 presents the reported consolidated costs and earnings in these areas. The MRR expenses are reported annually in Form 10-K, schedule XVI--Supplementary Income Statement Information. The other items are summarized in the 10-year financial summary presented in the 1976 annual report.

These widely-ranging relationships point out the multidimensional nature of MRR expenses (relating to Table 2-F13); while they do bear some relationship to capital expenditure activity, they are also affected by volume output as measured by net income. Examining the MRR expense history per se, however, reveals some interesting observations:

- 1) MRR has averaged \$576 million annually between 1967-1976, with a standard deviation of \$152 million. With the exception of 1975, when activities were curtailed, the MRR expense has not declined from any year to the next. The 1976 high level of MRR cost must result in some measure from maintenance and repairs deferred during 1975, in addition to rearrangements to accommodate a changing production mix.
- 2) Since MRR is predominantly payroll cost, the change in MRR in real terms can be deduced by indexing the reported expenses to Ford's hourly labor rate. The fully loaded payroll labor rates

TABLE 2-F12. DISAGGREGATED TOOLING AND CAPITAL INVESTMENTS-COMPARISON
(\$ MILLIONS)

<u>Year</u>	<u>Tooling Investment</u>	<u>Capital Investment</u>	<u>TOTAL</u>	<u>Tooling %</u>	<u>Capital %</u>
1967	285	373	658	43%	57%
1968	317	274	591	54%	46%
1969	322	322	644	50%	50%
1970	367	315	682	54%	46%
1971	327	330	657	50%	50%
1972	352	361	713	49%	51%
1973	395	432	827	48%	52%
1974	411	449	860	48%	52%
1975	274	194	468	59%	41%
1976	383	319	702	55%	45%

Source: Table 2-F6
Table 2-F11

TABLE 2-F13. ANNUAL EXPENSES FOR MAINTENANCE, REPAIRS, AND REARRANGEMENTS, FORD 1967-1976 (\$ MILLIONS)

- - - - - Capital Expenditures - - - - -										
Year	MRR	Net Earnings		P P & E		Tooling		TOTAL		
		\$	%	\$	%	\$	%	\$	%	
1967	412.1	84.1	490.0	661.1	62.3	374.8	110.0	1035.9	39.8	
1968	422.0	626.6	67.3	462.4	91.3	416.9	101.2	879.3	48.0	
1969	441.6	546.5	80.8	533.5	82.8	424.3	104.1	957.8	46.1	
1970	440.7	515.7	85.5	563.6	78.2	483.5	91.1	1047.1	42.1	
1971	495.9	656.7	75.5	608.8	81.5	430.4	115.2	1039.2	47.7	
1972	615.6	870.0	70.8	690.9	89.1	462.8	133.0	1153.7	53.4	
1973	702.0	906.5	77.4	891.7	78.7	594.3	118.1	1486.0	47.2	
1974	734.8	327.1	224.6	832.5	88.3	618.7	118.7	1451.4	50.6	
1975	664.4	322.7	205.9	614.2	108.2	342.2	194.2	956.4	69.5	
1976	829.4	983.1	84.4	551.0	150.5	503.7	164.7	1054.7	78.6	

Source: Company 10-K and annual reports.

per hour are presented in the Annual Report financial summary for 10 years. Using these rates an index was constructed (based on U.S. labor rates only). This index was applied to annual reported MRR figures to establish an adjusted historical trend. Table 2-F14 presents these results.

The average adjusted MRR is thus \$390 million per year. The standard deviation of these data is only \$36 million. On an indexed basis the MRR cost history appears more stable; thus, in real terms the strong relationship between MRR and the fixed asset base becomes more apparent. If one ignores the abnormal year 1975 the mean value of MRR for the remaining periods is \$398 million with a standard deviation of \$27 million--a remarkably stable pattern where there was apparent randomness previously.

The implication of these indexed results is that, as a corporation, Ford must devote a relatively constant portion of its labor resources to MRR each year. Swings off the dominant trend can be (and have been) caused by abnormal volume fluctuations, management austerity programs, and major production shifts.

Attempting to disaggregate these figures the project team was constrained to rely on analytical judgment, as essentially nothing is revealed by Ford as to geographical composition of MRR. The disaggregation factors were derived by first establishing a 90% factor to reflect auto/non-auto revenues, and then combining this 90% factor with the 73%/63% capital investment ratios developed previously (see Table 2-F5). The 1975 factor of 35% for capital investment was ignored as it was felt that MRR was too fixed in nature to allow extension of that ratio. The resulting disaggregation factors and disaggregated MRR are presented in Table 2-F15.

As a final step in MRR analysis, the project team adjusted the disaggregated MRR data by the wage index developed previously. The results are presented in Table 2-F16.

TABLE 2-F14. ANNUAL MRR COST ADJUSTED FOR WAGE-RATE INFLATION

<u>Year</u>	<u>Wage Rate Index</u>	<u>Reported MRR*</u>	<u>Adjusted MRR</u>
1967	100.0	412	412
1968	103.4	422	408
1969	109.5	442	404
1970	121.2	441	364
1971	136.6	496	363
1972	148.3	616	415
1973	159.7	702	440
1974	179.7	735	409
1975	207.6	664	320
1976	227.5	829	364

* Rounded to millions

Source: Company annual report and 10-K.

TABLE 2-F15. MAINTENANCE, REPAIRS AND REARRANGEMENTS EXPENSE ASSOCIATED WITH NORTH AMERICAN AUTOMOBILE AND LIGHT TRUCK, FORD 1967-1976
(\$ MILLIONS)

<u>Year</u>	<u>Consolidated MRR</u>	<u>Derived Factor</u>	<u>Derived MRR</u>
1967	412	0.66	272
1968	422	0.66	279
1969	442	0.66	292
1970	441	0.66	291
1971	496	0.66	327
1972	616	0.66	406
1973	702	0.66	463
1974	735	0.57	419
1975	664	0.57	378
1976	829	0.57	473

Source: Table 2-F13
ADL estimates as described

TABLE 2-F16. DERIVED MRR ADJUSTED FOR WAGE-RATE INFLATION (\$ MILLIONS)

<u>Year</u>	<u>MRR Derived</u>	<u>Index</u>	<u>Adjusted MRR</u>
1967	272	100.0	272
1968	279	103.4	270
1969	292	109.5	267
1970	291	121.2	240
1971	327	136.6	239
1972	406	148.3	274
1973	463	159.7	290
1974	419	179.7	233
1975	378	207.6	182
1976	473	277.5	208

Source: Table 2-F15
Table 2-F14

These data have a mean of \$248 million with a standard deviation of \$33 million. Ignoring 1975 data produces a mean of \$255 million with a standard deviation of \$26 million.

In summary, the disaggregation techniques used and assumptions developed lend support to an assertion that MRR activity is relatively constant within the company's operations, and in addition that volume changes only indirectly affect MRR, through the mechanism of enforced spending cutbacks and deferrals.

An interesting area for further pursuit would be multivariate analysis of MRR as it relates to sales, capital investment, and depreciation. If data could be developed from the manufacturers, the essential fixed/variable nature of MRR could be determined. This would be of significant benefit in performing break-even analyses.

e. Annual Operating Costs for Research and Development

Consolidated research and development (R&D) expenses are available from published reports of Ford for the years 1970-1976. Prior to 1970 the company was not required to reveal these amounts. The data presented in Table 2-F17 are derived from Form 10-K, schedule XVI. The amounts of interest are those termed "company-sponsored" research and development since Ford is in the business (through its subsidiary Ford Aerospace) of selling research and development as a service ("customer sponsored" R&D). The estimate for 1967-1969 were developed by performing a linear regression of total costs with R&D expense, using 1970, 1971 and 1972 as sample years.

The adjustment index, which is based on Ford's total payroll costs, demonstrates that a significant portion of the dramatic increase in R&D spending between 1967 and 1976 can be ascribed to inflation. While there is no doubt that on an adjusted or unadjusted basis R&D costs are significant (the 1976 cost of \$925 million could support an engineering staff of nearly 10,000 at an average fully-loaded cost of \$100,000 per year per engineer), the pattern of R&D spending does not appear to have been radically altered by regulation or legislation.

TABLE 2-F17. CONSOLIDATED COMPANY-SPONSORED RESEARCH AND DEVELOPMENT EXPENSE, FORD 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Consolidated R&D</u>	<u>Index of Wages</u>	<u>Adjusted R&D</u>
1967	328 (est.)	100.0	328
1968	416 (est.)	103.4	402
1969	446 (est.)	109.5	407
1970	449	121.2	370
1971	513	136.6	376
1972	621	148.3	419
1973	826	159.7	517
1974	825	179.7	459
1975	748	207.6	360
1976	925	227.5	407

Source: Company 10-K's
 Table 2-F14
 ADL estimates as described

Ford does not publish any information on the composition or nature of R&D expenses. Thus, for disaggregation purposes, the project team necessarily relied on elementary sales ratios, using an average of 65% for 1972-1976 and 72% for 1967-1971, based on the relationship of North American automobile and light truck sales to consolidated total sales. (See Table 2-F6 and discussion.) The resulting disaggregated R&D is presented in Table 2-F18.

The disaggregated R&D costs, on an adjusted basis, show a remarkably constant level of R&D spending over the period. The following observations should be made:

- 1) Attempts to develop information to help explain the pattern of R&D spending were blocked by an absolute lack of published information on this item. For example the sharp increase in R&D spending reported between 1972 and 1973 cannot be explained by reference to any published source.
- 2) R&D costs did not decline as sharply during 1975 as most of the other cost and investment items examined. This implies a basic fixed nature within these costs, as one would expect if the costs are in fact composed to a significant extent of engineering salary costs.
- 3) R&D costs were approximately 3% of sales (on either a consolidated or disaggregated basis) in 1970, and 3.2% of sales in 1976.

f. Annual Operating Costs for Depreciation and Amortization

The depreciation and amortization policies of Ford, as summarized in Part I of this report, are essentially in accord with general industry practice. That is among the property, plant and equipment accounts, land is not depreciated, land improvements and buildings are depreciated over a 30-year life, and machinery and equipment are depreciated on a 12-year life. The depreciation methods are sufficiently accelerated that accumulated depreciation amounts to two-thirds of total asset costs within the first half of the assets' lives. The precise depreciation methods used, however, are not revealed.

Amortization of special tools is performed over the short productive life of the tools, but the categorization of types of tooling and

TABLE 2-F18. DISAGGREGATED RESEARCH AND DEVELOPMENT EXPENSE, NORTH AMERICAN AUTOMOBILE AND LIGHT TRUCK, FORD 1967-1976 (\$ MILLIONS)

Year	Consolidated	Derived Factor	Derived R&D	Adjusted	Derived
	R&D			R&D	R&D
1967	328 (est.)	0.72	236		236
1968	416 (est.)	0.72	300		290
1969	446 (est.)	0.72	321		293
1970	449	0.72	323		267
1971	513	0.72	369		270
1972	621	0.65	404		272
1973	826	0.65	537		336
1974	825	0.65	536		298
1975	748	0.65	486		234
1976	925	0.65	601		264

Source: Table 2-F6
 Table 2-F17
 ADL estimates as described

productive life assumptions is not disclosed by the company. The reported consolidated depreciation and amortization for Ford 1967-1976 are presented in Table 2-F19.

The annual depreciation charges have increased steadily over the period, while amortization has been more variable. This basic distinction reflects the difference between the long-term capital nature of PP&E and the short-term, product-line orientation of tooling investments.

The disaggregation of PP&E depreciation was based on factors derived in the original disaggregation of capital expenditures. (For an alternative approach using an aggregation technique see the General Motors analysis.) In Table 2-F7 and the subsequent analysis it was shown that the estimated capital investments in the area of interest (i.e., North American automobile and light trucks) had averaged approximately 57% of total consolidated capital investments over the period 1967-1971, and approximately 49% of total capital investments over the period 1972-1976. To allow for the tendency of depreciation to lag and smooth the annual effects of capital investments, these two approximate fractions were taken as end points (57% in 1971, 49% in 1981) and two straight-line interpolations made between them and the historical 66% which was obtained prior to 1967. The resulting factors, and disaggregated depreciation expense on that basis, are presented in Table 2-F20.

These results (Table 2-F20) are in general agreement with what one would expect in a mature industry: relatively stable cash flows from depreciation, affected primarily in price level inflation of the assets being depreciated.

The annual costs of amortization of special tools were also disaggregated along parameters developed in the prior investment analysis. In this case the amortization reported on a consolidated basis was factored by the same percentages as were used to factor investments, but the factors were lagged 2 years to account for the

TABLE 2-F19. REPORTED CONSOLIDATED DEPRECIATION AND AMORTIZATION,
FORD 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Depreciation of PP&E</u>	<u>Amortization of Special Tools</u>	<u>TOTAL</u>
1967	345	331	676
1968	366	382	748
1969	385	418	803
1970	414	410	824
1971	427	396	823
1972	455	458	913
1973	485	463	948
1974	531	393	924
1975	584	435	1019
1976	590	431	1021

Source: Company 10-K's; Schedule XVI

TABLE 2-F20. ANNUAL DEPRECIATION EXPENSE RELATED TO NORTH AMERICAN AUTOMOBILE AND LIGHT TRUCK PRODUCTION, FORD 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Consolidated Depreciation</u>	<u>Estimated Factor</u>	<u>Derived Depreciation</u>
1967	345	66%	227
1968	366	64%	234
1969	385	62%	239
1970	414	59%	244
1971	427	57%	244
1972	455	56%	255
1973	485	55%	267
1974	531	54%	287
1975	584	53%	310
1976	590	52%	307

Source: Table 2-F19
 ADL estimates as described

spreading effect of amortization. The resulting factors and estimates are presented in Table 2-F21.

The resulting disaggregated amortization estimates have an average value of \$305 million annually with a standard deviation of \$30 million. Significantly the amounts for the latest three years are below the mean—even without the full effect of the curtailed spending of 1975 which will partially appear in 1977. The inference that tooling lives are being lengthened is apparent from this time series of data, especially when one considers volume growth and inflation over this period.

g. Summary

Table 2-F22 summarizes the various items of investment and expense estimated by the project team to be related to U.S. and Canadian automobile and light truck production.

TABLE 2-F21. ANNUAL AMORTIZATION EXPENSE RELATED TO NORTH AMERICAN AUTOMOBILE AND LIGHT TRUCK PRODUCTION, FORD 1967-1976 (\$ MILLIONS)

<u>Year</u>	<u>Consolidated Amortization</u>	<u>Estimated Factor</u>	<u>Derived Amortization</u>
1967	331	0.76	252
1968	382	0.76	290
1969	418	0.76	318
1970	410	0.76	312
1971	396	0.76	301
1972	458	0.76	348
1973	463	0.76	352
1974	393	0.76	299
1975	435	0.67	291
1976	431	0.67	289

Source: Tables 2-F10, 2-F11, 2-F19
ADL estimates as described

TABLE 2-F22. SUMMARY: ITEMS OF INVESTMENT AND EXPENSE RELATED TO FORD U.S. AND CANADIAN AUTO AND LIGHT TRUCK (\$ MILLIONS)

<u>Year</u>	<u>PP&E</u>	<u>Tooling</u>	<u>MRR</u>	<u>R&D</u>	<u>Dep'n.</u>	<u>Amort.</u>
1967	373	285	272	236	227	252
1968	274	317	279	300	234	290
1969	322	322	292	321	239	318
1970	315	367	291	323	244	312
1971	330	327	327	369	244	301
1972	361	352	406	404	255	348
1973	432	395	463	537	267	352
1974	449	411	419	536	287	299
1975	194	274	378	486	310	291
1976	319	383	473	601	307	289
Mean	337	343	360	411	261	305
Standard Deviation	74	46	78	122	30	30

2.3.4 GENERAL MOTORS

a. Size and Scope

GM, the second largest corporation in the world, is engaged in the manufacture, assembly and distribution of "motor driven products" most of which relate to transportation. The company reported consolidated revenues of \$47 billion in 1976 (see Table 2-G1). Form 10-K describes the business of the company as:

- 1) Automotive products consist of passenger cars, trucks, coaches (including motor homes), and major components therefore, as well as parts and accessories. The greater portion of such components, parts and accessories is used in the manufacture of General Motors automotive products. In addition, components, parts and accessories are sold to outside manufacturers, including other automobile, truck and coach manufacturers, and are also marketed through distributors, dealers and jobbers.
- 2) Nonautomotive products include household appliances, diesel engines, diesel locomotives, off-highway earth-moving equipment and other related products. In addition, the Corporation in recent years has enlarged and intensified its efforts in the area of urban transportation planning.
- 3) Defense and space products include turbine aircraft engines and components, ordnance transmissions, navigation and guidance systems and components, as well as commercial products delivered for use by the military. Additionally, the Corporation participates in related research and development programs.

This brief description, however, does not convey the enormous worldwide scope of its operation. Table 2-G1 shows the extent of the company's operations and facilities. In addition to the activities shown here the company has significant real estate, finance and insurance units which are not consolidated with the company's manufacturing operations.

TABLE 2-GI. WORLDWIDE SCOPE OF GM OPERATIONS

<u>Domestic Divisions</u>	<u>Products</u>	<u>Facilities</u>
A. Domestic-Car, Truck, Body, Service Parts and Assembly		
● Buick	Passenger Cars	Flint, MI
● Cadillac	Passenger Cars	Detroit, MI
● Chevrolet	Passenger Cars	Bay City, MI Buffalo, NY Cleveland, OH (2) Detroit, MI (3) Flint, MI (5) Indianapolis, IN Livonia, MI Massena, NY Muncie, IN Saginaw, MI (3) Toledo, OH Tonawanda, NY (3) Warren, MI
● GM Truck and Coach	Trucks/Buses/Military Vehicles/Motor Homes	Pontiac, MI
● Oldsmobile	Passenger Cars	Lansing, MI
● Pontiac	Passenger Cars	Pontiac, MI
● GM Assembly	Car and Truck Assembly	Arlington, TX Atlanta, GA Baltimore, MD Doraville, GA Framingham, MA Fremont, CA Janesville, WI Kansas City, KS Kansas City, MO Linden, NJ Lordstown, OH Norwood, OH South Gate, CA St. Louis, MO Tarrytown, NY Van Nuys, CA Wilmington, DE Ypsilanti, MI

TABLE 2-GI. WORLDWIDE SCOPE OF GM OPERATIONS (continued)

<u>Domestic Division</u>	<u>Products</u>	<u>Facilities</u>
● Fisher Body	Stamping	Chicago, IL Cleveland, OH Columbus, OH Detroit, MI (4) Elyria, OH Euclid, OH Flint, MI (2) Grand Bland, MI Grand Rapids, MI (2) Hamilton, OH Kalamazoo, MI Lansing, MI Livonia, MI Lordstown, OH Mansfield, OH Marion, IN Pittsburgh, PA Pontiac, MI Syracuse, NY Tecumseh, MI Trenton, NJ
● AC-Delco Guide)	Parts Distribution	42 locations
● GM Parts)		
B. Domestic Electrical Components		
● AC Spark Plug	Plugs/ filters/instrumentation/pumps/emission control/cruise control/electric braking	Anaheim, CA Anderson, IN Clinton, MA Dayton, OH Fitzgerald, GA Flint, MI Milwaukee, WI (2) Monroe, LA Muncie, IN New Brunswick, NJ Olathe, KS Rochester, NY Kokomo, IN Massena, NY Warren, OH
● Delco Electronics	Radios, air conditioners, (Same as above) auto electronics, inertial, navigating systems	

TABLE 2-GI. WORLDWIDE SCOPE OF GM OPERATIONS (continued)

<u>Domestic Division</u>	<u>Products</u>	<u>Facilities</u>
B. Domestic Electrical Components, cont'd.		
● Delco Products	Shocks/motors/hydraulic-electrical controls/wipers generators and suspension units	(Same as above)
● Delco-Remy	Ignitions/switches/vacuum controls/batteries	(Same as above)
● Packard Electric	Wiring systems/fiber optics/magnet wire	(Same as above)
● Rochester Products	Carburetors/diverter valves emission devices/lighters/locks/keys	(Same as above)
C. Domestic Mechanical Components		
● Central Foundry	Iron/steel/alloys/castings	Athens, GA Bedford, IN Bristol, CT Buffalo, NY Clark, NJ Danville, IL Dayton, OH (4) Defiance, OH Lockport, NY Saginaw, MI (2) Sandusky, OH Ypsilanti, MI
● Delco Air Conditioning	compressors	(Same as above)
● Delco Moraine	Brake systems/bearings transmission components	(Same as above)
● Harrison Radiators	Radiators/heat exchangers/heaters/thermostats/air conditioners	(Same as above)
● Hydra-Matic	Automotive Transmissions	(Same as above)
● Inland	Plastics/hose/ball joints	(Same as above)

TABLE 2-G1. WORLDWIDE SCOPE OF GM OPERATIONS (continued)

<u>Domestic Division</u>	<u>Products</u>	<u>Facilities</u>
C. Domestic Mechanical Components (cont'd.)		
● New Departure-Hyatt Bearings	Bearings	(Same as above)
● Saginaw Steering Gear	Steering/axles	(Same as above)
D. Domestic-Power and Appliance		
● Detroit Diesel Allison	H.D. diesel/gas turbines	Chicago, IL Cleveland, OH Detroit, MI Grand Rapids, MI Hudson, OH Indianapolis, IN La Grange, IL Romulus, MI
● Diesel Equipment	Fuel injectors/valves/ jet fuel nozzles/emission controls	(Same as above)
● Electro-Motive	Locomotives/generating plants/large diesels	(Same as above)
● Frigidaire	Household Appliances	(Same as above)
● GM Transportation	Mass transit	(Same as above)
● Terex	Construction equipment	(Same as above)
E. Domestic-Other		
● Training Centers	Mechanic training	30 locations
●		
● Technical Centers	Engineering/test and labs	Warren, MI Denver, CO Van Nuys, CA

TABLE 2-GI. WORLDWIDE SCOPE OF GM OPERATIONS (continued)

<u>Overseas Divisions</u>	<u>Products</u>	<u>Facilities</u>
A. GM Canada	Autos/trucks;buses/ engines/power plants/ terex	London, Oshawa, St. Catherine, Scarboro, Windsor, St. Theresa
B. Vauxhall/Bedford (England)	Autos/trucks	Luton, Dunstable, Ellesnore Port
C. Holden (Australia)	Autos/utility vehicles	
D. Opel (West Germany)	Autos/light commercial vehicles	Russelsheim, Rochum, Kaiserslantern
E. Chevrolet (Brazil)	Autos/trucks/terex	Sao Paulo
F. Chevrolet (Argentina)	Autos/trucks	
G. Chevrolet (Mexico)	Autos/trucks	

Source: Moody's Industrial Manual

The ensuing analysis is made especially complicated because of the magnitude and interrelationships among these broad range of activities. This analysis of specific company data concentrates on the following items:

- 1) Investment in property, plant and equipment
- 2) Investment in special tooling
- 3) Operating costs for maintenance, repair and rearrangement
- 4) Operating costs for research and development
- 5) Operating costs for depreciation and amortization

The initial base of analysis is the Form 10-K. However, as this report is a consolidated statement of worldwide operations the initial analytical step involves identification of appropriate investments and costs for North American automotive. The analysis beyond this first step, however, centered around whatever information was available to the project team.

b. Annual Investments in Property, Plant and Equipment

GM has reported annual consolidated capital expenditures for property, plant and equipment over the last ten years (1967-1976) ranging from a low of \$860 million in 1968 to a high of \$1458 million in 1974. Table 2-G2 shows the amount and nature of these worldwide capital expenditures which include investments for nonautomotive and vehicles over 10,000 lbs. GVW.

Before proceeding to an analysis of this item the following observation should be noted:

- 1) Inflation is a significant factor in the apparent growth of capital expenditures. Table 2-G3 illustrates the effect of inflation on annual capital expenditures. The indexes used are for the U.S. while the costs are worldwide but it is unlikely that any refinements would have a material effect.
- 2) Expenditures in real terms are declining. A linear regression calculation shows annual investments for building and equipment declining at the rate of \$12 million and \$6 million respectively. This trend fits the normative profile of a company with GM's

TABLE 2-G2. CONSOLIDATED INVESTMENT IN PROPERTY, PLANT AND EQUIPMENT
1967-1976 (\$ MILLIONS)

<u>YEAR</u>	<u>LAND</u>	<u>BUILDING</u>	<u>MACHINERY AND EQUIPMENT</u>	<u>CONSTRUCTION IN PROGRESS</u>	<u>TOTAL</u>
1967	35	167	674	37	913
1968	38	196	695	(69)	860
1969	53	144	648	199	1044
1970	40	241	918	(65)	1134
1971	28	230	782	(28)	1012
1972	37	144	857	(98)	940
1973	52	133	759	219	1163
1974	45	192	1002	219	1458
1975	49	238	1034	(120)	1201
1976	30	99	1023	(153)	999

Source: Company 10-K reports

TABLE 2-G3. CAPITAL EXPENDITURES IN ESTIMATED CONSTANT 1967 DOLLARS

YEAR	BUILDINGS			EQUIPMENT		
	ACTUAL(1)	INDEX(2)	DEFLATED	ACTUAL(1)	INDEX(3)	DEFLATED
1967	167	100	167	674	100	674
1968	196	107	183	695	103	675
1969	144	115	125	648	107	606
1970	241	123	196	918	111	827
1971	230	134	172	782	116	674
1972	144	145	100	857	118	726
1973	133	154	86	759	122	622
1974	192	172	112	1002	139	721
1975	238	189	126	1034	161	642
1976	99	204(est.)	49	1023	173(est.)	591

Sources:

- (1) Form 10-K
- (2) E.H. Breckh Building Cost Index
- (3) U.S. Bureau of Labor Statistics, Wholesale Prices and Price Indexes - Machinery and Equipment

strong-to-dominant market position in a mature industry; flat to declining investment in real terms.

For the years 1967-1976 GM has consistently reported the level of spending in the U.S. as being between 80-85%. Canadian expenditures have been infrequently reported but have usually mounted to 4% of total capital spending for this purpose. Table 2-G4 shows the estimates expenditures in the U.S. and Canada.

In the U.S. and Canada, however, GM is a multi-industry company and it is necessary to allocate this investment between automotive and nonautomotive. The former is defined for the purposes of this study as being all vehicles of GVWR 10,000 pounds or less. As the company does not disclose its data in a manner suitable for this study's purposes the project team derived its data for this item by the following disaggregation process:

- 1) Assign investment in property, plant and equipment to the (a) automotive, (b) nonautomotive, and (c) defense and space categories used by the company on the basis of sales. This allocation has obvious weaknesses because of the differing investment rates between industries and the mix in categories (b) and (c). However, given the dominance of the first categories the differences can only be minor. For instance, a 20% error in estimating non-auto investment would result in a less than 2% error in the estimated auto investment. Table 2-G5 shows this information.
- 2) Allocate total automotive investment between (a) cars and vehicles under 10,000 lbs. GVW and (b) other, also on a sales weighted basis. Of course, the plant which produces the non-passenger vehicles is physically undistinguished in the main as between vehicle sizes. In order to develop this allocation it was necessary to calculate the estimated U.S. and Canadian sales for vehicles over 10,000 lbs. GVW. This information is not readily available but the project team arrived at an estimate of 6% of total U.S. and Canadian sales for the latter class. Table 2-G6 shows this estimate was developed.

Total U.S. sales for GM, therefore, for the five years 1972-1976 amounted to approximately \$7.4 billion. Assuming market shares and vehicle weight distributions are similar in Canada this would add \$1.4 billion in

TABLE 2-G4. CAPITAL SPENDING IN UNITED STATES FOR PROPERTY, PLANT AND EQUIPMENT (\$ MILLIONS)

<u>YEAR</u>	<u>TOTAL</u>	<u>% U.S./Can. (1)</u>	<u>TOTAL U.S./Can.</u>
1967	913	84	767
1968	860	84	722
1969	1044	84	877
1970	1134	84	952
1971	1012	84	850
1972	940	83	780
1973	1163	85	988
1974	1458	85	1239
1975	1201	85	1021
1976	999	84	839

Source: Form 10-K and ADL estimates

(1) Not consistently available but assumed 84%; 1972-1976 reported in annual report.

TABLE 2-G5. ALLOCATION OF UNITED STATES/CANADIAN INVESTMENT

<u>YEAR</u>	<u>AUTO</u>	<u>NON-AUTO</u>	<u>SPACE</u>	<u>TOTAL</u>
Sale Allocation Ratio (1)	<u>92%</u>	<u>7%</u>	<u>1%</u>	<u>100%</u>
1967	706	54	7	767
1968	664	51	7	722
1969	807	61	9	877
1970	876	67	9	952
1971	782	60	8	850
1972	718	54	8	780
1973	909	69	10	988
1974	1140	87	12	1239
1975	939	72	10	1021
1976	772	59	8	839

(1) (a) Canadian sales split in same proportion between auto and non-auto as U.S. excluding space.
 (b) Sales basis used in 1972-76 to level out year by year variations.

TABLE 2-G6. GM SALES OF VEHICLES OVER 10,000 LBS. GVWR

YEAR	INDUSTRY-U.S.					GM SHARE (3)	SALES \$Mill.		
	UNITS (1) (000)		SALES (2) (\$ MILLIONS)						
	<10	>10	TOTAL	<10	>10				
1967	1185	354	3590	1893	1697	40	678		
1968	1517	379	4670	2669	2001	40	800		
1969	1538	385	4940	2821	2118	40	847		
1970	1354	338	4820	2756	2064	33	681		
1971	1683	370	5960	3989	1971	42	828		
1972	2055	391	7650	4870	2780	42	1167		
1973	2503	477	9540	6070	3470	40	1388		
1974	2264	464	10160	6292	3868	38	1470		
1975	1954	318	9900	6600	3300	40	1320		
1976	2622	357	17700	12567	5133	42	2053		

(1) Source: Automotive News(2) (a) Source: Motor Vehicle Manufacturers Association reports
(b) ADL Sales weighted estimate 1:3(3) Sources: Standard and Poor's Industry Survey
ADL estimate

revenues. Total revenues from vehicles over 10,000 lbs. GVW amount to \$8.8 billion or 6% of total U.S. and Canadian revenue for "automotive" sources.

- 3) The derived estimate for investment in property, plant and equipment for the U.S. and Canadian automotive is approximately 73% of total expenditures worldwide. (Table 2-G7.)

The project team's literature search and additional analysis to further explain this item uncovered the following data:

- 1) Changes to company-owned property have been minor relative to the total property, during years 1972-1976. The table below shows these changes;

- manufacturing	4% increase
- assembling	11% increase
- parts depots	3% increase
- R&D facilities	2% increase
- Administration and sales	3% increase

These amounts are net of retirements and include automotive, nonautomotive and space. Assembly space is more likely to be sensitive to unit volume changes and the latter has increased by 7% over the same period in the U.S. and Canada (Form 10-K). There have been remarkably few changes of substance in the total amount of property owned.

- 1) Significant increments to facilities and equipment.

The information available on the significant increments to facilities and equipment is highly fragmented and incomplete. Nevertheless, the project team pieced together the composite shown in Table 2-G8.

This information cannot be related directly to the amounts shown in the annual reports. Timing differences between announced commitments and actual expenditures vary so widely that any relationship would be highly speculative.

TABLE 2-G7. INVESTMENT IN AUTOMOTIVE U.S./CANADA

YEAR	CONSOLIDATED	TOTAL U.S./CANADA(1)	AUTOMOBILE AND LIGHT TRUCK		OTHER VEHICLES(2) 6%
			94%	(% Total)	
1967	913	706	664	73	42
1968	860	664	624	73	40
1969	1044	807	759	73	48
1970	1134	876	823	73	53
1971	1012	782	735	73	47
1972	940	718	675	72	43
1973	1163	909	854	73	55
1974	1458	1140	1071	73	69
1975	1201	939	882	73	57
1976	999	772	725	73	47

1. See Table 2-G5

2. See Table 2-G6

TABLE 2-G8. SIGNIFICANT INCREMENTS TO FACILITIES AND EQUIPMENT

YEAR	INCREMENTS		DETAIL	SOURCE	COST (\$Million)	NOTES	
	DIVISION	LOCATION					
1972	Buick	Flint, MI	"Major Outlay Planned" for expansion and modernization-No further information given	Auto Industries 3/15/72	Estimate of auto plan incurred in 1972 and 1973. Total announced \$1.1 billion		
	Pontiac	Pontiac, MI					
	Chevrolet	Saginaw, MI					
	Delco Moraine	Dayton, OH					
	Delco Products	Dayton, OH					
	Assembly	Tarrytown, NY					
	Fisher	Flint, MI					
	Chevrolet G & A	Detroit, MI					
	Cadillac	Detroit, MI					
	Fisher	Detroit, MI					
1973	Corporate	Detroit, MI				Announced Only Not Available	
	Oldsmobile	Lansing, MI	"Extensive Modernization and Expansion" (Delayed and restarted in 1976)	Annual Report 1972	Not Available		
	Fisher	Lansing, MI					
	GM Assembly	Memphis, TN					
1974	GM Assembly	Oklahoma City, OK	Blazer and other assembly - 1.2 million sq. ft. Passenger car assembly	Wall Street Journal 8/10/73	50	Completion 1974 (delayed in 1974)	
	Chevrolet	Southgate, CA					
					250	Completion 1975 (delayed in 1974)	
						Full plant conversion	

TABLE 2-G8. SIGNIFICANT INCREMENTS TO FACILITIES AND EQUIPMENT (continued)

<u>YEAR</u>	<u>INCREMENTS</u>	<u>LOCATION</u>	<u>DETAIL</u>	<u>SOURCE</u>	<u>COST</u> (\$ Million)	<u>NOTES</u>
<u>DIVISION</u>						
Research Labs	Warren, MI		Increased facilities by 50%	Annual Report 1973	N/A	Second year of program
1974	AC Spark Plug	Milwaukee, WI	Catalytic Wards 9/30/74 converters Prod. add. 375 thous. sq. ft.	100		
Chevrolet	Flint, MI		Tooling for Chevette type Market 2/25/74 engine. Prod. planned for 1976	75	Range given 50-100	
Chevrolet	Flint, MI		Conventional 4 and 6 cyl-inder	American Metal Market 6/24/74	150	Over 100 given Program not firm
Pontiac	Pontiac, MI		4 and 6 cyl-inder engines	American Metal Market 3/18/74	50+	Program not firm
Chevrolet	Flint, MI		Expand engine capacity	Supplied in AMM- N/A 6/24/74		
1975	Oldsmobile	Lansing, MI	V-8 replacement order	AMM-12/8/75	20	50% usual cert. est.

TABLE 2-G8. SIGNIFICANT INCREMENTS TO FACILITIES AND EQUIPMENT (continued)

<u>YEAR</u>	<u>INCREMENTS</u>	<u>LOCATION</u>	<u>DETAIL</u>	<u>SOURCE</u>	<u>COST (\$ Million)</u>	<u>NOTES</u>
<u>DIVISION</u>	<u>LOCATION</u>					
						"Fraction of 100"
Pontiac	Pontiac, MI	Minor V-8 retooling orders	AMM-12/8/75	10		
1976	Delco-Remy	Meridian, MS	250 thou. sq. ft. for Journal 9/22/75 Chevette starters	Wall Street Journal 2/1/77		
	Saginaw	Decatur, AL	Steering gear plant	Wall Street Journal 2/1/77		
	Oldsmobile	Lansing, MI	Diesel engine for 88 & 98	New York Times 200 2/26/77		Available on 1978 models. Cost industry source est.
	Chevrolet	Tonawanda, NY	(a) New V-6 AMM-4/19/76 and (b) modified V-8	(a) 100 (b) 50		50% of full program
1976	Oldsmobile	Lansing, MI	V-8 re- tooling	AMM-1/12/76	10	See Pontiac 1975
	Hydromatic	Ypsilanti, MI	Automatic/ Transaxle Manual/ Transaxle	AMM-5/24/76	100	
	Chevrolet	Muncie, IN	Plastics:			
	Chevrolet	Adrian, MI	813 thou. sq. ft.	Journal of Commerce	N/A	

TABLE 2-G8. SIGNIFICANT INCREMENTS TO FACILITIES AND EQUIPMENT (continued)

<u>YEAR</u>	<u>INCREMENTS</u>	<u>LOCATION</u>	<u>DETAIL</u>	<u>SOURCE</u>	<u>COST</u> (\$ Million)	<u>NOTES</u>
<u>DIVISION</u>						
Chevrolet	Masseur, NY	Aluminum Die Casting		Journal of Commerce	N/A	
GMC Truck	Pontiac, MI	Major conversion to van prod.		Journal of Commerce	N/A	
Delco Products	Kettering, OH	Major additions		Journal of Commerce	N/A	
Delco Electronics	Kokomo, IN	Major additions		Journal of Commerce	N/A	

2) Expenditures to meet regulatory requirements.

Table 2-G9 shows the reported expenditures for facilities and tools to meet regulatory requirements. The data given in the 10-K is consolidated and therefore includes expenditures for all purposes. The project team has consequently adjusted the data given to reflect automotive only.

These expenditures should be treated with caution for the amounts tend to be included in data given as plant costs. It is not likely, however, they would be included in special tooling.

3) Replacement values.

The project team speculated on the concept that most of GM's capital expenditures have been for replacement purposes in the manner of a mature business. Experience with manufacturing organization holds that the economic life used for calculating depreciation is about half of the actual life of the assets. With this principle the team compared investments of twenty years prior to 1972-1976, for comparison purposes, adjusted at a compound growth rate of 3%. Table 2-G10 shows the results.

With the exception of 1976, which was an abnormally low year, the speculations appear verified that the majority of the company's expenditures are for replacement purposes.

c. Annual Investments in Special Tooling

The definition of what constitutes "special tooling" must be addressed at the outset. The only definition found by the project team was in the The Tool and Die Industry-Problems and Prospects, by H.E. Arnett and D.N. Smith, University of Michigan.

- 1) Dies: A die set consists of a pair of cutting shaping tools which, when moved toward each other, produce a certain desired form in, or impress a desired device on, an object or surface by pressure or a sharp force. The term "die" may also refer to one of the basic die set members; the "punch" is the other.
- 2) Jigs and fixtures: Jigs are devices for supporting the workpiece and for guiding the cutting tool of the machine tool during processing. Fixtures are of several types, but the more typical ones support or hold in place a workpiece during its processing;

TABLE 2-G9. CAPITAL EXPENDITURES TO MEET REGULATORY REQUIREMENTS
(\$ MILLIONS)

<u>Year</u>	<u>Emissions</u>	<u>Safety</u>	<u>Pollution</u>
% Auto	<u>100</u>	<u>75</u>	<u>75</u>
1972	90	131	44
1973	124	223	-
1974	284	69	-
1975	41	56	-
1976	28	29	-

Source: Form 10-K
ADL estimates

TABLE 2-G10. ADJUSTMENT OF PRIOR INVESTMENT COSTS TO "CURRENT" VALUE (\$ MILLIONS)

<u>YEAR</u>	<u>AMOUNT</u> (1)	<u>ADJUSTED VALUE</u>	<u>YEAR</u>	<u>ACTUAL AMOUNT</u>
1952	343	619	1972	940
1953	501	905	1973	1163
1954	755	1364	1974	1458
1955	608	1098	1975	1201
1956	891	1609	1976	999

Source: Annual Reports

others are used in assembly and checking operations. In general, jigs and fixtures may do all or some of the following operations: locate, clamp or support a workpiece, and guide a tool. Fixtures normally are not involved in the latter operation.

- 3) Mold: A device that forms parts as molten metal, rubber, plastic, or comparable material is fed into it.
- 4) Gage: An instrument used to determine whether a given part dimension is within specified tolerance limits.
- 5) Special machines: Nonstandard machine tools, usually used for metalworking operations, and mostly of a metal-removal type.

GM has reported annual consolidated capital expenditures for special tooling over the years 1967 to 1976 ranging from a low of \$631 million in 1971 to a high of \$1308 million in 1976. Table 2-G11 shows the annual expenditures worldwide in actual and adjusted dollars.

This data was surprising to the project team for the following reasons:

- 1) The mean investment in adjusted dollars for the ten years was \$780 million with a standard deviation of \$59 million (adjusting for the abnormal 70/71 period). For a company the size of GM this seemed a consistent rate of expenditure.
- 2) A trendline calculation shows expenditures declining at the rate of \$15 million per year.

While the project team recognizes that the price index is only an approximation for the impact of inflation on real expenditures, it nevertheless remains a perplexing factor that investment in special tooling could be flat to declining regardless of the considerable publicity given to increased expenditures from the auto companies. However, the major impact of the "downsizing" program was not felt until 1976, when there was an increase recorded over 1975 but still less than the mean for the ten year period.

Interestingly, Arnett & Smith remarked upon a general decline in the industry; "the body tooling segment has been declining since the late 1960's. In 1974 and 1975 the demand for body tooling declined to

TABLE 2-G11. CONSOLIDATED ANNUAL EXPENDITURES FOR SPECIAL TOOLING
(\$ MILLIONS)

<u>YEAR</u>	<u>AMOUNT</u>	<u>INDEX (1)</u>	<u>ADJUSTED VALUE</u>
1967	861	100	861
1968	866	103	841
1969	863	107	807
1970	1149	111	1035
1971	631	116	544
1972	899	118	762
1973	941	122	771
1974	1096	139	788
1975	1036	161	643
1976	1308	173 (est.)	756

(1) U.S. Bureau of Labor statistics, Wholesale Prices and Price
Indexes - Machinery and Equipment

Source: Form 10-K

post-World War II lows" (page 49). The authors, moreover, discussed how the decline came about and what caused it. "This decline resulted not only because of the recession, but also was significantly attributable to the lengthening of the body style change cycle from approximately three years to five or six years. Precipitated by many factors, the stretchout resulted mainly from the need to utilize much of the available tooling budget for implementing federally mandated safety and emission standards." The concept that the tooling budget has been fixed is intriguing. The pattern of styling changes could presumably be set by this factor first and market demand second. Does the downsizing program imply a further stretchout in design changes? Can the strategic balance in the industry be upset by one company altering the budget/styling cycle relationship (if it exists)?

The company does not publish the amount of investment in the U.S. and Canada for special tooling as it did for property, plant and equipment. The project team could only develop this amount by inference from several sources:

- 1) Arnett & Smith estimate that "approximately 80-90 percent of the total special tooling expenditures (of the big four) is automotive relative and procured in the U.S."
- 2) GM representatives at hearings before the Subcommittee on Small Business Problems (1969) stated "die-construction for outer and inner panels and other sheet metal parts for General Motors passenger cars...represents approximately 75 to 80 percent of our average annual die-construction needs for all purposes."
- 3) A source formerly associated with the industry estimated that tooling expenditures for automotive are proportionately higher than the auto/non-auto sales ratio.

The project team, therefore, believes that it is reasonable to infer from this information that the tooling costs for North American and Canadian automotive (including light trucks) would be approximately 85% of the total. Table 2-G12 shows the amounts for this item.

TABLE 2-G12. INVESTMENT FOR TOOLING IN U.S. AND CANADA (\$ MILLIONS)

<u>YEAR</u>	<u>TOTAL</u>	<u>U.S./CANADA AUTO.</u>
1967	861	732
1968	866	736
1969	863	734
1970	1149	977
1971	631	536
1972	899	764
1973	941	800
1974	1096	932
1975	1036	881
1976	1308	1112

In attempting to analyze these expenditures the project team encountered numerous classification and definition problems:

- 1) Cost: GM produces "slightly more than half" of its tooling requirements in-house (Subcommittee hearings). A study by W.A. Patton and R.L. Davis, "Make-or-Buy Decisions in Tooling for Auto Production," (University of Michigan) indicated that "characteristic all-inclusive rates in job shops range from 70-130% of direct labor cost; comparable rates for large captive shops appear to range from 250-400%."

Thus, data obtained on the "cost" of tooling for a certain purpose is highly subjective; the estimates used herein must be treated with caution.

- 2) Body Classification: GM offers a wide range of vehicles in its auto and truck divisions (Chevrolet-car and truck, Pontiac, Oldsmobile, Buick, Cadillac and GM truck). The consumer views these body sizes in terms of full-size, intermediate, compact, sub-compact for autos and light trucks and vans for others. The company has a more refined auto body classification which relates to the foregoing as shown in Table 2-G13.

This classification has variations for marketing purposes; the full-size further breaks down into standard, medium and high. The present purpose is to classify tooling costs which are more effected by size than by price or quality features. However, this assumption may not hold for long because of the appearance of downsized vehicles. The Seville, for instance, has a smaller wheelbase than the Chevelle.

- 3) Model Changes: A major complexity arises with attempting to classify the extent of model changes, which range from the cosmetic to a complete new model. The project team could not locate any classification system already established but believes the following to serve the purpose of this study:

- Cosmetic: grill, fender or single panel changes (roof line)
- Minor: cosmetic plus several panels (roof, trunk, door, hood)
- Major: extensive changes in appearance of all exterior sheet metal

TABLE 2-G13. BODY CLASSIFICATIONS

<u>CONSUMER</u>	<u>COMPANY</u>	<u>MODELS</u>
- Sub-compact	T	Chevette
	H	Vega, Astre, Monza, Starfire, Skyhawk
- Compact	X	Nova, Ventura, Omega, Apollo
	F	Camaro, Firebird
- Intermediate	A	Chevelle, LeMans, Cutlass, Century
	G	Monte Carlo, Grand Prix
- Full-size	B	Chevy, Pontiac, Olds, Buick
	C	Olds 98, Electra, Cadillac
	D	Fleetwood, Limousine
	K	Seville
	E	Toronado, Riviera, Eldorado

- New Model:

Base - completely new car

Division modification)
Specials) Spinoff from base model

- Downsized: New car with extensive mechanical component redesign to fit the new concept.

It is not always obvious into which category a particular model change should be placed and the ensuing classification is the project team's estimate.

- 4) Tooling Cost: One of the most difficult tasks for the project team was trying to locate reliable and consistent data on tooling costs. Little information exists and what little does is obscured by questions of (a) the extent of the change, (b) size of the auto, (c) made or bought, (d) company quoted (GM supposedly spends more), and (e) run size anticipated (the larger the run the more quality built into the tools).

Table 2-G14 displays the project team's estimate of the various classification costs for GM.

The estimates shown in Table 2-G14 are based upon several observations:

- Arnett & Smith estimated the Pacer cost at 50-60 million dollars. GM spends about twice as much according to industry sources.
- Industry sources contacted concerning the cost of a downsized vehicle provided the above estimates, and asserted that the cost would be approximately fifty percent greater than the previous cost of a new vehicle.
- American Metal Market (Feb. 2, 1975) estimated the total tooling cost of the Chevette program at \$200 million. This included the engine program.

It was surprising to the project team that there was such little public information available on this important subject. Moreover, the estimates obtained were highly indefinite. The full estimation developed above is based on interpolation of the limited data received.

- 5) Expenditure Scheduling: A Harvard Business School case study on Chrysler (July 1974) indicated that construction of tool and die began 12-18 months before introduction of the model. Individuals formerly associated with GM

TABLE 2-G14. TOOLING COSTS (1975 DOLLARS) (\$ MILLIONS)

<u>Changes</u>	<u>MODEL</u>					
	<u>Sub-Comp.</u>	<u>Compact</u>	<u>Inter.</u>	<u>Full-Size</u>	<u>Light Trucks</u>	<u>Vans</u>
5	5	5	5	5	5	5
1- Cosmetic						
2- Minor	20	20	20	20	20	20
3- Major	50	60	75	75	50	40
New Model						
4- Base	100	120	140	140	90	70
5- Other	30	40	50	50	30	20
6- Downsized (excel. engine/ transmission)	140	180	220	220	140	100

Source: ADL Estimates

indicated that the process could be as long as three years prior to introduction of a new model, but basically agree that the "bulk" of the expenditures were incurred in the year of introduction.

For these reasons, the project team assumed the following:

<u>Changes</u>	<u>When Expended</u>
- Cosmetic/minor	Year of introduction
- Other	70% year of introduction
	30% year proceeding introduction

The final step in analyzing the nature of expenditures for special tooling involved a review of Ward's Automotive Yearbooks 1973/77. Table 2-G15 shows the various model line changes as they relate to the financial years 1972-1976.

Based on this information the project team estimated the cost of these model line changes using the cost estimates derived in Table 2-G14. The resultant cost of model line changes is displayed in Table 2-G16. The results obtained, while it would be incorrect to exaggerate their merit, tend to reinforce or suggest the following:

- 1) The derived estimates (Table 2-G12) for special tooling. The model line analysis is within ranges which could be considered reasonably related to the macro-disaggregation.
- 2) Approximately one-third of the annual cost for special tooling is for cosmetic or minor changes.
- 3) Industry analysts claim that major restyling changes take place about every three years with minor changes each year.

d. Annual Operating Costs for Maintenance, Repairs and Rearrangements

The costs of maintenance, repairs and rearrangements (MRR is a particularly troublesome but nonetheless a particularly relevant item in trying to understand the impact of legislative changes on the economics of the auto companies. MRR contains expenses related to:

- 1) Rearrangement of plants - this is done to accommodate switching of model production from one plant to another or to accommodate the introduction of a new line. Only in exceptional cases where a plant is gutted would the amount be capitalized, according to an industry source.
- 2) Tooling repairs - replacement or repair of tooling for reasons other than model changes are included under this heading.

TABLE 2-G15. MODEL LINE CHANGES 1972-76

MODEL LINE & BODY	1976 $\frac{1}{1} \frac{2}{2} \frac{3}{3} \frac{4}{4} \frac{5}{5} \frac{6}{6}$	1975 $\frac{1}{1} \frac{2}{2} \frac{3}{3} \frac{4}{4} \frac{5}{5} \frac{6}{6}$	1974 $\frac{1}{1} \frac{2}{2} \frac{3}{3} \frac{4}{4} \frac{5}{5} \frac{6}{6}$	1973 $\frac{1}{1} \frac{2}{2} \frac{3}{3} \frac{4}{4} \frac{5}{5} \frac{6}{6}$	1972 $\frac{1}{1} \frac{2}{2} \frac{3}{3} \frac{4}{4} \frac{5}{5} \frac{6}{6}$
SUB-COMPACT					
T	1	1	1	1	1
H	3	1	4	1	1
COMPACT					
X	3	1	3	1	1
F	2	2	1	2	2
INTERMEDIATE					
A	1	3	1	(a)	1
G	1	1	1	1	4
SPECIAL	1	1	1	1	1
FULL-SIZE					
B	1	(b)	2	1	1
C	1	1	2	1	3
D	1	1	1	1	1
E	2	1	2	1	1
K	1	1	1	1	1
LIGHT TRUCKS				1	1
VANS				2	1

TABLE 2-G15. MODEL LINE CHANGES 1972-76 (continued)

	1976	1975	1974	1973	1972
OTHER	<u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u>				
J		1 (a)			

(a) Under development in 1976
 (b) Full 'B' body downsizing program

Source: Ward's Automotive Yearbook
 ADL estimates

TABLE 2-G16. COST OF MODEL LINE CHANGES

MODEL LINE

TABLE 2-G16. COST OF MODEL LINE CHANGES (continued)

MODEL LINE

	CHANGES (\$MM)	YEAR					
		1976 No. 50	1975 No. 1	1974 No. 50	1973 No. 50	1972 No. 50	
TRUCKS	3						
TOTALS			<u>985</u>	<u>685</u>	<u>765</u>	<u>455</u>	<u>1050</u>

(a) Vendor development in 1976
 (b) Full 'B' body program

Source: ADL estimates

- 3) Normal maintenance and repair - the usual costs of maintaining and repairing the facilities and equipment of the company are included under this heading.

As was mentioned in the first part of this report, it is frequently a matter of judgment as to whether or not a given item of expenditure should be treated as capital or expense and with the subjectivity involved it is a matter of no small import the effect the judgment has on reported results. Table 2-G17 shows the amount of MRR and its relationship to reported profits and capital expenditures.

The following points should be noted:

- 1) MRR has averaged \$1741 million over the last ten years. The standard deviation is \$388. This variability is surprising because such an item is typically regarded as being largely fixed in an efficient manufacturing environment. The project team could only infer that it is more highly influenced by new model introduction and tooling repairs than is usual.
- 2) The amount of MRR is declining in real terms. An industry source indicated that this item is largely payroll-related. The company in its 1976 Form 10-K indicated that payroll costs grew at a compound rate of almost 12% over the last three years. If the growth in the previous seven years were only half this rate then Table 2-G18 would represent this item in real terms.
- 3) Capital expenditures range between 1.0 and 1.5 times the cost of MRR.
- 4) Earnings after tax appears to have no direct correlation to MRR; except that it tends to drop when earnings drop significantly.

There was little or no useful information found by the project team to be available on the composition of MRR. The project team felt that in the case of GM the estimation of the U.S./Canadian automotive costs for this purpose would be influenced most by the year to year capital expenditures. Table 2-G19 shows how this item would break down under this assumption. Industry sources contacted confirmed that this item is significantly effected by model changes.

TABLE 2-G17. ANNUAL EXPENSES FOR MAINTENANCE, REPAIRS AND REARRANGEMENT (\$ MILLIONS)

YEAR	MRR	Capital Expenditures								
		Profits after Tax		P P & E			TOOLING		TOTAL	
		\$	%	\$	%	\$	%	\$	%	
1967	1824	1627	89	913	50	881	48	1794	98	
1968	2033	1732	85	860	42	866	43	1726	85	
1969	1280	1711	134	1044	82	863	67	1907	149	
1970	1135	609	54	1134	100	1149	101	2283	201	
1971	1479	1935	131	1012	68	631	43	1643	111	
1972	1632	2162	132	940	58	899	55	1839	113	
1973	2026	2398	118	1163	57	941	46	2104	103	
1974	1855	950	51	1458	79	1096	59	2554	138	
1975	1701	1253	74	1201	71	1036	61	2237	132	
1976	2453	2902	118	999	41	1308	53	2307	94	

TABLE 2-G18. ADJUSTED MRR SPENDING

<u>YEAR</u>	<u>INDEX</u>	<u>AMOUNT</u>
1967	100	1824
1968	106	1918
1969	112	1143
1970	119	954
1971	126	1174
1972	134	1218
1973	142	1427
1974	159	1167
1975	178	956
1976	200	1227

Source: Table 2-G17 and index derived as described

TABLE 2-G19. ANNUAL EXPENSES FOR REPAIRS, MAINTENANCE AND REARRANGEMENT IN U.S. AND CANADA AUTO (\$ MILLIONS)

YEAR	INVESTMENTS			%	MRR Expense	
	TOTAL	U.S./CANADA	%		TOTAL	U.S./CANADA
1967	1794	1396	78		1824	1423
1968	1726	1360	79		2033	1606
1969	1907	1493	78		1280	998
1970	2283	1800	79		1135	897
1971	1643	1271	77		1479	1139
1972	1839	1439	78		1632	1273
1973	2104	1654	79		2026	1601
1974	2554	2003	78		1855	1447
1975	2237	1763	79		1701	1344
1976	2307	1837	80		2453	1962

Source: Form 10-K's
ADL estimates

Additional information of particular interest to this study, but unavailable to the project team, would include the separation of costs between operating and extraordinary charges (the latter including plant modifications and tooling replacements). The project team believes that this information could not be obtained without the company's assistance.

e. Annual Operating Costs for Research & Development

The company has reported the following consolidated annual operating costs for research and development:

TABLE 2-G20. OPERATING COSTS FOR RESEARCH & DEVELOPMENT (\$ MILLIONS)

<u>YEAR</u>	<u>AMOUNT</u>	<u>INDEX (1)</u>	<u>ADJUSTED VALUE</u>
1967	(est.) 601	100	601
1968	(est.) 683	106	644
1969	(est.) 728	112	650
1970	749	119	629
1971	839	126	666
1972	880	134	657
1973	1018	142	717
1974	1125	159	708
1975	1114	178	626
1976	1257	200	628

(1) See Maintenance, Repairs and Rearrangements analysis

Source: Company 10-K's; 1967-1969 estimated based on sales.

Although total research and development costs have doubled during the period 1967-76 growth on an adjusted value basis has been much more modest.

The company does not publish any information on the composition of research and development expenditures. However, the following observations and data are noteworthy:

- 1) GM's research and development expenditures amount to 3% of company sales.
- 2) The company has disclosed its total expenditures for research, engineering, reliability, inspecting and testing on government mandated changes. Research and engineering are not identified separately and it is assumed the other items are contained in product cost. However, the following data has been disclosed:

Total Expenditures-\$ millions

	'76	'75	'74	'73	'72
- Emission Control	160	144	170	186	148
- Automotive Safety	316	273	322	356	332

GM does not offer any information of the cost of fuel economy regulations except in general terms. The company speaks of its redesign program but does not distinguish between its cyclical redesign efforts. Furthermore, it is a debatable issue as to whether or not fuel economy is both government and market demanded.

- 1) Industry sources provided the following information on research and development expenditures:
 - Split between product and manufacturing process research and development is approximately 95% and 5% respectively.
 - Product related research and development breaks down as follows:

	%
Advanced Vehicle	5
Vehicle Package	5
Vehicle Testing	3
Body Engineering	20
Seat Ornamentation	10
Engines and Accessories	15
Transmission	10
Axles	3
Electrical	5
Frame and Suspension	5
Steering	2
Brake Systems	2
Design-Styling	5
Current Model	10
Total	100

- Engineering and Launching costs can range between 10-20% of the capital expenditures program. Based upon this information the project team derived the following (Table 2-G21) estimates of research and development costs for U.S. and Canadian automotive.

TABLE 2-G21. RESEARCH AND DEVELOPMENT U.S./CANADA AUTOMOTIVE (\$ MILLIONS)

<u>YEAR</u>	<u>AMOUNT</u>	<u>U.S./CANADA (1)</u>
1967	(est.) 601	439
1968	(est.) 683	499
1969	(est.) 728	531
1970	749	547
1971	839	612
1972	880	642
1973	1018	743
1974	1125	821
1975	1114	813
1976	1257	918

(1) Estimated 73% of total (sales basis)

Source: Table 2-G20
ADL estimates as described

The sales-based allocation was reviewed in relationship to space occupied by research and development facilities in U.S./Canada and overseas. This has been split approximately 80-20% in the last five years and, as the former includes nonautomotive research and development, the sales-based estimate would appear reasonable (see Table 2-G22).

f. Operating Costs for Depreciation and Amortization

The general depreciation policies of GM were described in Part I of this report. In its form 10-K the company states that: "Depreciation is provided on groups of property using, with minor exceptions, an accelerated method which accumulates depreciation of approximately two-thirds of the depreciable cost during the first half of the estimated lives of the property.

The annual group rates of depreciation are as follows:

<u>Classification of Property</u>	<u>Annual Group Rates</u>
Land improvements	5%
Buildings	3-1/2%
Machinery and Equipment	8-1/3% (Average)
Furniture and office equipment....	6% (Average)

Expenditures for special tools are amortized, with the amortization applied directly to the asset account, over short periods of time because the utility value of the tools is radically affected by frequent changes in the design of the functional components and appearance of the product. Replacement of special tools for reasons other than changes in products is charged directly to cost of sales."

TABLE 2-G22. SQUARE FEET OF PROPERTY OWNED. GENERAL MOTORS - U.S. & CANADA* 1972-1976

SQUARE FEET IN THOUSANDS

	1976	1975	1974	1973	1972
MANUFACTURING FACILITIES					
CHANGE FROM PREVIOUS YEAR	150,755	151,111	148,709	146,599	144,624
% CHANGE FROM PREVIOUS YEAR	-356 -.2%	2,402 1.6%	2,110 1.4%	975 1.4%	266 -.2%
ASSEMBLY FACILITIES					
CHANGE FROM PREVIOUS YEAR	70,690	71,055	70,609	69,640	63,657
% CHANGE FROM PREVIOUS YEAR	-365 -.5%	466 .6%	969 1.4%	5,983 9.4%	2,282 3.7%
PARTS DEPOTS & WAREHOUSING					
CHANGE FROM PREVIOUS YEAR	18,816	19,334	19,469	18,773	18,334
% CHANGE FROM PREVIOUS YEAR	-518 -2.7%	-135 -.7%	696 3.7%	439 2.4%	61 -.3%
R & D FACILITIES					
CHANGE FROM PREVIOUS YEAR	14,494	14,446	14,046	13,799	14,210
% CHANGE FROM PREVIOUS YEAR	48 .3%	400 2.8%	247 1.8%	-411 -2.9%	550 4%
ADMIN. & SALES OFFICES					
CHANGE FROM PREVIOUS YEAR	21,735	22,203	21,896	21,949	21,072
% CHANGE FROM PREVIOUS YEAR	-468 -2.1%	307 1.4%	53 .2%	877 4.2%	2,272 -9.7%

Source: Form 10-K

*Allocated Owned Square Feet on Basis of Leased/Owned.

Neither the accelerated method of depreciation utilized nor assumed economic life of the assets are given, however. But it does seem reasonable to infer from the information given that the economic life and depreciation method used are as follows:

	<u>Age</u>	<u>Method</u>
Land improvements	20 yrs.	Straight Line
Buildings	30 yrs.	Straight Line
Machinery and Equipment	10 yrs.	Sum of year digits
Furniture and Office Equipment	15 yrs.	Sum of year digits

Industry analysts support the assumptions made. Furthermore, the project team was also informed that a rule of thumb for amortization is one year for minor model changes and three years for major changes. However, amortization techniques frequently set the write-off to estimated production levels. Consequently, the amortization of major tooling may not be linear over the next three years.

Reported consolidated depreciation and amortization for the years 1967-76 are given in Table 2-G23. The former has grown in a relatively steady manner while the latter has been somewhat more erratic. The average depreciation charge was \$841 million with a standard deviation of \$81 million. Amortization averaged \$947 million with a standard deviation of \$184 million. This greater volatility is to be expected because of the direct and immediate relationship to model line changes.

The project team estimated the annual charge for depreciation and amortization relating to U.S./Canadian automotive on a two-part approach. Base depreciation was calculated using the average rates given in the 10-K applied against the estimated assets on the books in 1967. The second step attempted a more exact calculation based on the assumed depreciation techniques described earlier and the calculated incremental investments in U.S./Canadian automotive.

Tables 2-G24 and 25 display the results of the analysis. The results are within the range of what might be expected; although not entirely satisfactory most of the difficulties could result from timing

TABLE 2-G23. CONSOLIDATED DEPRECIATION & AMORTIZATION (\$ MILLIONS)

<u>YEAR</u>	<u>DEPRECIATION</u>	<u>AMORTIZATION</u>	<u>TOTAL</u>
1967	713	840	1553
1968	729	853	1582
1969	766	892	1658
1970	821	677	1498
1971	873	917	1790
1972	912	874	1786
1973	903	1081	1984
1974	847	858	1705
1975	906	1180	2086
1976	939	1297	2236

TABLE 2-G24. DEPRECIATION RELATED TO U.S./CANADIAN AUTOMOTIVE (\$ MILLIONS)

INVESTMENT				DEPRECIATION									
				<u>67</u>	<u>68</u>	<u>69</u>	<u>70</u>	<u>71</u>	<u>72</u>	<u>73</u>	<u>74</u>	<u>75</u>	<u>76</u>
A	Base A - Buildings	1530	(net)	90	90	90	90	90	90	90	90	90	90
	B - M & E	2070	(net)	460	402	345	288	230	173	115	56		
B	67	B	110	4	4	4	4	4	4	4	4	4	4
	M & E	554	100	90	81	71	61	50	40	30	20		10
8	B	104	3	3	3	3	3	3	3	3	3	3	3
	M & E	520	94	85	76	67	58	49	40	33		24	
9	B	126	4	4	4	4	4	4	4	4	4	4	4
	M & E	633	115	104	92	81	69	58	46			35	
70	B	137	5	5	5	5	5	5	5	5	5	5	5
	M & E	686	125	112	100	87	75	62				50	
1	B	123	4	4	4	4	4	4	4	4	4	4	4
	M & E	612	111	100	89	78	67					56	
2	B	113	4	4	4	4	4	4	4	4	4	4	4
	M & E	562	102	92	82	72						61	
3	B	142	5	5	5	5						5	5
	M & E	712	129	117	104							91	
4	B	179	6	6	6	6						6	6
	M & E	892	162	146	130								

TABLE 2-G24. DEPRECIATION RELATED TO U.S./CANADIAN AUTOMOTIVE (\$ MILLIONS) (Continued)

		INVESTMENT	DEPRECIATION									
			<u>67</u>	<u>68</u>	<u>69</u>	<u>70</u>	<u>71</u>	<u>72</u>	<u>73</u>	<u>74</u>	<u>75</u>	<u>76</u>
5	B	147									5	
	M & E	735									120	
6	B	121									4	
	M & E	604									110	
			—	—	—	—	—	—	—	—	—	
	TOTAL		654	683	727	770	783	778	789	823	814	821

A - Assumed 90% of total U.S./Canada

B - Increments split 1:5 (historic 1:3) to reflect less investment in buildings.

TABLE 2-G25. AMORTIZATION RELATED TO U.S./CANADIAN AUTOMOTIVE

		Investment	<u>67</u>	<u>68</u>	<u>69</u>	<u>70</u>	<u>71</u>	<u>72</u>	<u>73</u>	<u>74</u>	<u>75</u>	<u>76</u>
A.	Base	448	224	224								
B.	67	Minor	224	224								
		Major	508	169	169	170						
	68		245	245								
			491	163	163	164						
	69		245	245								
			489	163	163	163						
	70		326	326								
			651	217	217	217						
	71		179		179							
			357		119	119	119					
	72		255		255							
			509		169	170	170	170				
	73		267		267							
			533		177	178	178	178				
	74		310			310						
			621			207	207	207	207	207		
	75		294				294					
			587				195	195	195	195	196	
	76		371								371	
			741								247	
<u>TOTAL</u>	Adj.		<u>617</u>	<u>801</u>	<u>741</u>	<u>870</u>	<u>678</u>	<u>760</u>	<u>733</u>	<u>865</u>	<u>874</u>	<u>1021</u>
			<u>50</u>	<u>(50)</u>	<u>100</u>	<u>(250)</u>	<u>150</u>	<u>760</u>	<u>100</u>	<u>(100)</u>	<u>874</u>	<u>1021</u>
	Consolidated		<u>667</u>	<u>751</u>	<u>841</u>	<u>620</u>	<u>828</u>	<u>874</u>	<u>1081</u>	<u>765</u>	<u>858</u>	<u>1180</u>
			<u>840</u>	<u>853</u>	<u>892</u>	<u>677</u>	<u>917</u>					<u>1297</u>

variances or variations in calculating methods. Rather than change this data to fit our expectations the project team left the results intact to display the methodology (with the exception of minor but obvious timing adjustments to amortization).

g. Summary

Table 2-G26 summarizes the various items of investment and expense estimated by the project team to be related to U.S. and Canadian automotive.

TABLE 2-G26. SUMMARY: ITEMS OF INVESTMENT AND EXPENSE RELATED TO U.S./CANADIAN AUTOMOTIVE (\$ MILLIONS)

<u>YEAR</u>	<u>PP & E</u>	<u>TOOLING</u>	<u>MRR</u>	<u>R & D</u>	<u>DEPRE- CIATION</u>	<u>AMORTI- ZATION</u>
1967	664	732	1423	439	654	667
1968	624	736	1606	499	683	751
1969	759	734	998	531	727	841
1970	823	977	897	547	770	620
1971	735	536	1139	612	783	828
1972	675	764	1273	642	778	760
1973	854	800	1601	743	789	833
1974	1071	932	1447	821	823	765
1975	882	881	1344	893	814	874
1976	725	1112	1962	918	821	1021
Mean	781	820	1369	657	764	796
Standard Deviation	132	161	315	159	58	112

2.4 LIMITATIONS OF ANALYSIS

The objective of this section of the report is briefly to describe how the results may best be viewed and also indicate how subsequent analysis of future years might proceed. It is not the objective here to discuss the limitations of the disaggregation approach itself; this was done in Section 2.2 Alternative Approaches.

Perhaps the most important observation to be made about the financial data developed in this analysis is that they are historical. The entire thrust of the analysis has been to examine, disaggregate and explain past actions and events. While there is little question that many of the resulting relationships and rules-of-thumb will be applicable in the analysis of future years' results, it will nonetheless be incumbent upon the analyst to re-examine the entire chain of assumptions and logic leading up to a derived ratio. This must be done to determine whether the context of the future results is sufficiently similar or in fact too basically different to permit analysis using the same techniques.

At the generalized level, it is appropriate to note that derived relationships which demonstrate good historical stability can most probably be used as initial probes into future results. Those relationships derived herein which show an erratic or random pattern must clearly be re-examined each time an attempt is made to apply them.

More specifically, the events of the years 1974-1976, as partially evidenced by the analysis in this report, could lead to profound changes in the automobile industry. While the data and techniques developed in this report are expected to provide insight into the direction, magnitude and effects of those changes, the very changes themselves will tend to make some of the relationships developed in this analysis obsolete. Thus, the first area the analyst must examine to assess future applicability of these data and tools is the

composition and nature of the industry itself. Some critical parameters follow:

- 1) Number of competitors
- 2) Market share stability
- 3) Domestic and worldwide shares, for domestic and international competitors
- 4) Product policies
- 5) Capacity utilization
- 6) Stockholder concentration

Changes in any of these dimensions will have effects on the financial and microeconomic activity of each competitor.

The second area the analyst must examine in using these data for future reporting periods is the nature of the individual company itself. The wide range of extraneous information (from number of employees to tooling make-or-buy policies) brought into the present analysis offers a clue to the types of corporate information which must be assessed as any analysis is undertaken. Some of the more apparent areas of question for an individual corporation are:

- 1) Degree of diversification
- 2) Degree of integration
- 3) Product policies
- 4) Domestic and international strategies
- 5) Research and development posture
- 6) Changes in market position

Finally, the analyst attempting to employ these data and tools against future reports must be aware of changes in the accounting policies and procedures of the companies, as well as changes in reporting requirements, as discussed for this period of analysis in Part I. Areas of examination for significant change include:

- 1) Principles of consolidation
- 2) Price-level accounting
- 3) Line of business reporting

The analyst who attempts to build upon the analysis provided in this report will be best served to interrogate each of these areas of sensitivity to either assure himself that no significant changes have occurred or to determine if alternative assumptions or logic are required. The essential limitations of the analysis are simply the factual contexts in which it was undertaken.

2.5 SENSITIVITY OF ACCOUNTS ANALYZED TO POTENTIAL CHANGES

The project team proceeded to assess the sensitivity of the accounts analyzed to potential changes in (1) reporting procedures and regulations, and (2) areas of impacts (technology and mandated changes). Obviously, there can be no definitive cause/effect relationship demonstrated because the auto companies are large, complex organizations that will react to change in a myriad of ways: the study of the corporate body rests more with the uncertain techniques of the social sciences rather than the more confident science of biology. The purpose of this section, however, is to assess the sensitivity to change, in a generic sense, of those accounts just analyzed.

2.5.1 CHANGES IN REPORTING PROCEDURES AND REGULATIONS

The last several years have seen an "activist" group heading the Securities and Exchange Commission who have raised most of the controversial issues on reporting procedures and regulations. There are few likely additional changes in the near term as recent changes are digested. It is possible, however, that some changes may not hold. The following are the salient areas of potential changes:

a) Replacement Cost Accounting

The debate continues on the value of replacement cost accounting. One faction holds that indexing is an arbitrary method of reflecting replacement value while the other claims that, whatever the limitations, the objective of measuring assets and profit on a current value basis warrants continued efforts to improve the calculation process. The use of replacement cost accounting will most likely not change the primary position of historic cost accounting basis. The main value will be in providing clues to the potential replacement cost for existing assets.

b) Financial Forecasting

Perhaps the most potent feasible change is in the area of financial forecasting. The SEC has made a series of rule and form proposals designed to implement the "Statement by the Commission on the Disclosure of Projections of Future Economic Performance." (Release 33-5362) The proposals

outlined by the SEC do not require disclosure of projections to the public but are intended to facilitate the integration of projections into the disclosure systems when a company chooses to make its projections available to the public.

Although voluntary at the moment, should the SEC's recommendations be required then the information available to DOT on projections of future investment, depreciation, research and development, maintenance, repair and rearrangement, and the assumptions on which they are based would be invaluable.

The SEC's proposals have met with considerable opposition from industry who fear the problems of legal liabilities and disclosures of competitive information.

c) Line of Business Reporting

As was mentioned in the first part of this report, bona fide disclosure of line of business data will provide DOT with valuable information on the disaggregation of consolidated data.

With these exceptions there are few likely changes anticipated in the future that would affect the subject of this report.

2.5.2 AREAS OF IMPACT

Numerous environmental factors derived from (a) the implementation of technology (b) mandated design changes (c) tax policies (d) government incentive and (e) energy conservation would effect the accounts analyzed but in ways difficult to predict at the moment. The following potential effects should be considered:

a) Downsizing Program

The affect of designing and producing more fuel-economical vehicles will have the tendency to reduce the number of product offerings in a structural sense; product differentiation will be on interior and accessory packages. This would represent a fundamental change in product concept. The cost of redesigning a basically new product will be incrementally greater than the previous product development costs. This

would impact the accounts analyzed in the following manner:

- Investment in Property, Plant and Equipment:

This item would not change materially as a result of a downsizing program. (Exception: see Technology) The project team did not obtain information which suggests that the investment in this area is particularly product related.

- Investment in Special Tooling:

This item would be affected directly. The cost of tooling for a downsized product is greater because of the larger parts redesign effort than has been traditional: opportunities for interchangeability is also reduced. However, should the auto companies move in the direction of the overseas manufacturers and stretch out the styling and product change cycles (as it appears AMC and Chrysler have already done) then the additional cost will be offset to some extent.

- Depreciation and Amortization:

Depreciation would not be affected. Amortization expense would move in the same manner as tooling investment.

- Maintenance, Repairs and Rearrangements:

MRR would be affected by product change as the plants are modified to accept production of the different vehicles. However, given the flexibility in classifying capital and expense items it may be that investment in property, plant and equipment would change; particularly, in a period of declining earnings.

- Research and Development:

Because the bulk of the companies' R&D cost is product related this item would move in a similar manner to tooling costs.

b) Technology Programs

The most likely area of technical change in the near term is with drive train programs. Engines, transmissions and axles are all being redesigned to accommodate fuel-economy requirements. The project team feels that this is the area of greatest impact on the accounts analyzed. Drive trains are becoming more vehicle-dependent as they are designed more to the product than they have been in the past.

Furthermore, there is not the same turnover as there is with body change so that the incremental effect will be greater. The principal affects will be:

- Investment in Property, Plant and Equipment:

This item will be most directly affected by drive train programs. Each identified program will likely add incrementally, without reduction, to the investment.

- Investment in Special Tooling:

This should not change as it is mostly body related.

- Depreciation and Amortization:

Depreciation would be affected but given the long life periods on which the calculations are based the change should not be great initially but rather be a cumulative impact.

- Maintenance, Repair and Rearrangements:

This item would be affected in the same manner as the downsizing program.

- Research and Development:

The companies have had to spend more than in the past on drive train work and a significant incremental impact is on R&D.

It is feasible, however, that some of the costs might be associated with equipment design and thus capitalized. The companies also have flexibility in making these determinations.

c) Tax Policy Changes

Changes in tax policy could affect the accounts analyzed in two ways. Firstly, an attempt to reduce or eliminate the corporate income tax would tend to reduce the pressure to expense items rather than capitalize them. Thus, the following impacts might be expected:

- MRR would decline as those judgment items are capitalized. Conversely, investments would increase.
- R&D might decrease also as more equipment related costs are capitalized.
- Depreciation and amortization would likely decrease as accelerated methods of calculation would be discontinued.

The second possible change in tax policies which might affect the accounts analyzed relate to the investment tax credit and tax depreciation methods. Both of which correctly favor investment. Any attempt to reduce these benefits would put greater pressure on expensing certain items which might otherwise be capitalized.

d) Government Incentives

The most likely form of government incentive would relate to extraordinary expenditures resulting from mandated design changes or environmental programs. Given that these are typically measured on investments made to recognize the one-time nature of the expense and to avoid operating subsidies, it could be expected that they would tend to increase reported investments and reduce expenses.

APPENDIX A

BIBLIOGRAPHY AND DISCUSSION OF DATA SOURCES

A. INTRODUCTION

As noted in the text of the Final Report, the primary sources for information for the study analysis were the stockholders' annual reports and SEC annual report on Form 10-K for each of the companies for each of the years 1967-1976.

In addition to these basic sources, several areas of published information were investigated to develop additional factual data and industry insights. The most extensive area of literature search was the trade and financial press. Concentrating on the years 1972-1976, and also limiting the area of interest to costs and capital spending (that is, eliminating the numerous articles dealing with sales and production figures and forecasts), the literature search examined indexes of the following periodicals:

American Metal Market	Journal of Commerce
Automotive Industries	Journal of Law & Economics
Automotive News	Journal of Political Economy
Barron's	Labor Law Journal
Business Week	Metalworking News
Commercial & Financial Chronicle	Michigan Business Review
Dun's Review	Modern Manufacturing
Economist	Modern Plastics
Electronic News	New York Times
Financial Analysts Journal	Nation's Business
Financial World	Sales Management
Finance	Value Line
Forbes	Wall Street Journal
Fortune	Wall Street Transcript
Harvard Business Review	Ward's Automotive Reports
Industry Week	Fleet Owner
Ironage	

Additionally, recent stock issue prospectuses were discovered for several companies.

The pertinent articles discovered in this effort are listed on the following pages as Part I of the bibliography: Literature Search Results.

A second area of investigation for referenceable sources was the publications and prints of the U.S. Government, primarily congressional committee prints. Only a few relevant sources were developed; they are listed as Part II of the bibliography: U.S. Government Publications.

The final area of research was that of academic books, monographs, and publications. The sources developed in this search are listed in Part III of the bibliography: Academic Publications.

The articles listed in Part I of the bibliography are organized into six sections, as follows:

- A. General Industry Information
- B. Regulation
- C. Suppliers
- D. Technological Trends
- E. Costs
- F. Specific Manufacturers
 - 1. American Motors
 - 2. Chrysler
 - 3. Ford
 - 4. General Motors

For each manufacturer there are two subcategories: (a) Capital Spending and (b) General.

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C. DISCUSSION OF DATA SOURCES

In attempting to develop useful external information to assist in the disaggregation process described in this report, the project team gained an understanding of the utility of various data sources for the purposes of financial analysis. This section of the appendix will briefly relate the conclusions of the project team in these areas. Excluded from discussion here are the basic financial reports themselves, which are the primary subject of the analysis itself and thus are discussed extensively therein.

1. Trade and Financial Press

These sources are essentially journalistic, concerning themselves primarily with current affairs. One cannot expect much in the way of an industry-general perspective or historical perspective from these sources. In addition, the trade press (periodicals serving the auto industry or its suppliers) depends almost entirely on the industry itself for information. A perusal of the bibliography will demonstrate that often a single company news release will generate four or five articles in various publications. Only very rarely do the trade press articles add more information or understanding than is in the company-written press release initially.

The financial press tends to provide more immediate analysis and discussion of company news items, but the primary concern of these journals is to forecast earnings performance of the corporations including all of their operations. Additionally, because their audience does not generally have a comprehensive interest in or understanding of the automobile industry, the relationships developed and conclusions drawn tend to be simplistic and generalized.

2. Government Publications

These sources, primarily hearings and committee prints, are useful for the purposes of this analysis only insofar as

industry testimony or information is provided. In terms of the sources developed herein, useful testimony and information is remarkably scanty. The industry is characteristically laconic when appearing at these proceedings. (Alternatively, the respondent will engage in a tactic of information overloading, wherein masses of irrelevant and tedious information are supplied.)

In summary, these sources must be mined extensively to develop a few nuggets of useful information.

3. Academic Publications

These sources tend to be products of economists, not financial analysts, and thus are heavily oriented towards macroeconomic trends and relationships. In general, the sources of information used in these reports and papers are generally more useful in and of themselves. Thus, the primary utility of academic publications is in their listing of sources and references.

APPENDIX B
REPORT OF INVENTIONS

After a diligent review of work performed under this contract, no new innovation, discovery, improvement or invention was made. However, analysis was performed on the historical financial characteristics of the U.S. automobile manufacturers for 1967-1976. The data collection and analysis were organized into a data base framework which can be extended as new financial information becomes available.

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